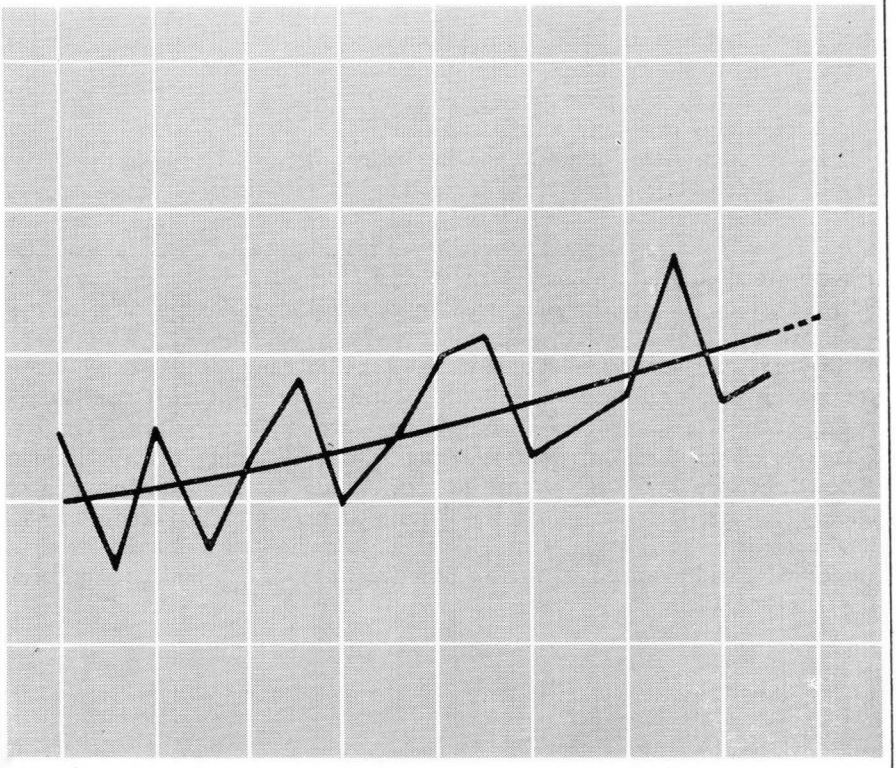
Demand Characteristics for Selected FRUITS in Honolulu, Hawaii 1947–1961



Jerry Foytik

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FOREWORD

This report analyzes monthly prices for avocados, bananas, papayas, tangerines, and watermelons at the Honolulu wholesale market. The main part of the report indicates the problem encountered, describes the methodology employed, and presents the results derived. It is followed by appendices giving various statistical data used in the course of this investigation and some methodology notes.

The empirically determined monthly "demand" functions indicate how prices fluctuate in response to variations in certain related factors. They provide the basis for answers to some questions. Among these are:

1. What is the net price-quantity relation?
2. How does it shift seasonally and annually?
3. Are adjustments in production justified?
4. Is demand interrelated with procurement activities of large-scale food retailers?

This study represents the first attempt at making a detailed price analysis for Hawaii-produced fruits. Although the results reported leave some questions unanswered, they do give an understanding of the price-making process for some products sold in one market.

Research for the report was conducted under Hawaii's phase of Western Regional Marketing Project WM-40, entitled "Procurement Policies and Practices of Large-Scale Food Retailers." The Agricultural Experiment Stations of California, Colorado, Hawaii, Idaho, Oregon, Washington, and Wyoming, and the Economic Research Service of the U.S. Department of Agriculture are cooperating in conducting various phases of this regional research program. The study on which this report is based is financed by Federal funds authorized under the Hatch Act (amended), and allocated to Project 367 (revised) of the Hawaii Agricultural Experiment Station.

Demand Characteristics for Selected Fruits in Honolulu, Hawaii, 1947–1961

JERRY FOYTIK

UNIVERSITY OF HAWAII
COLLEGE OF TROPICAL AGRICULTURE
HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII DECEMBER 1964

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Demand Characteristics for Selected Fruits in Honolulu, Hawaii, 1947–1961

JERRY FOYTIK[1]

This study is oriented toward deriving the demand relations facing handlers who sell fruit at the Honolulu wholesale market. Major emphasis is placed upon temporal shifts in demand levels. Specifically, the investigation is concerned with the demand in Honolulu's wholesale market for avocados, bananas, papayas, tangerines, and watermelons during 1947–61. These fruits, representing about half of the supply of all fruits marketed fresh in Honolulu and a much greater proportion of the volume produced within the State, are the only ones for which price and supply data are reported regularly for an extended period of time. They differ substantially in the growing areas from which Honolulu's supplies arrive, in physical characteristics, and even in their use within the household. Nevertheless, the statistical demand functions are similar in several ways.[2]

Average *ex post* relations, determined empirically for 1947–61, show that:

1. Changes in market supply are responsible for much of the variation in monthly prices of Hawaii-grown fruits. The net price-quantity relations are parabolic with a slight convex curvilinearity.
2. Temporal shifts in demand level are substantial and systematic. Annual changes are approximated by a cubic function. A cubic function describes the intraseasonal variations for tangerines and watermelons; a more complex function is needed for the other three fruits.
3. Demand elasticity also changes temporally. Variations arising from trend and seasonal shifts in demand level (and the quantity marketed) are greater, in general, than differences among averages for the five fruits.

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[1] During August 1962–July 1963, when this study was conducted, the author was Agricultural Economist at the Hawaii Agricultural Experiment Station and Visiting Professor of Agricultural Economics, University of Hawaii, while on leave from the University of California at Davis.

[2] Also compare with the results obtained for snap beans, cucumbers, and tomatoes reported in an earlier bulletin: Jerry Foytik, "Demand Characteristics for Vine Vegetables in Honolulu, Hawaii, 1947–1961," University of Hawaii, Agricultural Economics Bulletin No. 23, 68 pp., July 1964.

Although not necessarily descriptive of theoretical demand functions, the relations derived indicate the major factors responsible for variations in monthly wholesale prices and provide insight into the actual behavior of terminal market prices. Thus, the results give a basis for evaluating probable price and income effects of past changes in production and marketing practices and for considering those that may result from shifts in prospect for the immediate future.

The report begins with a historical prospective, briefly relating the marketing of fruits to the Honolulu market. Then, in sequence, the method of analysis is outlined, the results are presented, and their implications are discussed. The report ends with methodological and statistical appendices.

A. PRELIMINARY CONSIDERATIONS

Some aspects of the Hawaii fruit industry, of particular relevance to this price analysis, are recapitulated here to indicate the character of the Honolulu wholesale market and the nature of its demand for fruits. Attention is also directed toward describing seasonal changes in supply and price.

1. Role of the Honolulu Produce Market

Hawaii, separated by over 2,000 miles from its nearest continental neighbors, is located on an island chain some 400 miles long. The State is fragmented further into numerous land islands created by high mountains and deep valleys. Its population is distributed unevenly over the land area of the State. Over 80 percent of the population, which totaled 700,000 in 1962, reside on Oahu, the island where Honolulu is situated.

Honolulu, as the State's population and trading center, draws to its markets substantial quantities of the fresh fruits and vegetables grown on the Neighbor Islands. Only limited amounts of a few vegetables and none of the fruits grown on Oahu are shipped to the other islands. Practically all of the produce imported into the State comes first to Honolulu.[3]

Since Honolulu is a "pocket" market, supplies of fresh fruits and vegetables cannot be augmented quickly when local production drops below market needs and, conversely, local surpluses cannot be diverted readily to other markets. Hence, variations in market supply often lead to sharp price fluctuations, especially when Hawaii's own production is markedly above or below average or when supplies from outside sources are cut off or sharply reduced by transportation interruptions.

Commercial fruit production in Hawaii is limited mainly to tangerines and watermelons, and to tropical fruits, such as avocados, bananas, mangos, papayas, and pineapples. Other fruits, constituting about half of the fresh fruit supply sold in Honolulu, come almost entirely from the continental United States.

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[3] As used in this report, "imports" refers to supplies reaching Hawaii from any sources outside the State and "exports" to supplies shipped from the State. Most produce shipments from the continental United States or foreign countries to the Neighbor Islands go directly to the individual islands. In some cases, the ships may stop at Honolulu first, but there is little transshipment of produce from Honolulu to the other islands.

Hawaii farmers supply local needs for many fruits inadequately for various reasons. There are production problems associated with the State's semitropical climate and the topography of land available for producing fruit.[4] Most fruit farms are quite small, averaging only 2.8 acres, which hinders the introduction of cost-reducing techniques of production, harvesting, and marketing. The State's geographic isolation and population distribution make transportation an important factor. Farmers must import a large proportion of the inputs used in production, thus incurring relatively high freight charges. Motor trucks cannot be used to haul supplies to Honolulu except from growing areas located on Oahu. Air and surface transportation result in added expense and added delay, respectively, in moving produce to the major market. Coordination between farmers and wholesalers is poor because a relatively large number of wholesalers handle produce in the Honolulu market.

For these and other reasons fruit production is not a major enterprise in Hawaii, with the exception of pineapple. Commercial production is limited to 2,200 acres in contrast to acreages of about 14,000 for other diversified crops, 75,000 for pineapple, and 225,000 for sugar cane. Except for pineapple, which is grown mainly for export as canned pineapple and pineapple juice, Hawaii farmers produce fruits primarily for fresh use within the State. Relatively small quantities of the other fruits are processed or shipped fresh from the State.[5]

Honolulu's wholesale produce market includes two distinct and separate locations, both of which are poorly situated as to accessibility and space. Although produce moves through the market in a simple and direct manner, the market structure is characterized by small-scale and service-type operations, which keep wholesalers' margins at relatively high levels. For example, Honolulu wholesalers continue to regrade and repack locally grown fruits and vegetables, to make frequent deliveries, and to provide liberal credit terms. Commission selling is customary for fruits and vegetables produced in the State, whereas very little imported produce is shipped to Hawaii on consignment. The conventional wholesaler has lost ground in recent years because of increased direct buying by retailers, especially of imported produce.

Until the close of World War II, food retailing in Hawaii was dominated by the small, service-type, independent store, usually operated by the owner and his family with a minimum of hired help. This independent operator purchased supplies from conventional wholesalers. Since then, food retailing has undergone important and rapid changes. Possibly the most significant of these, particularly on Oahu, is the rapid growth in mass merchandising occasioned by the rise of supermarkets to a dominant position.

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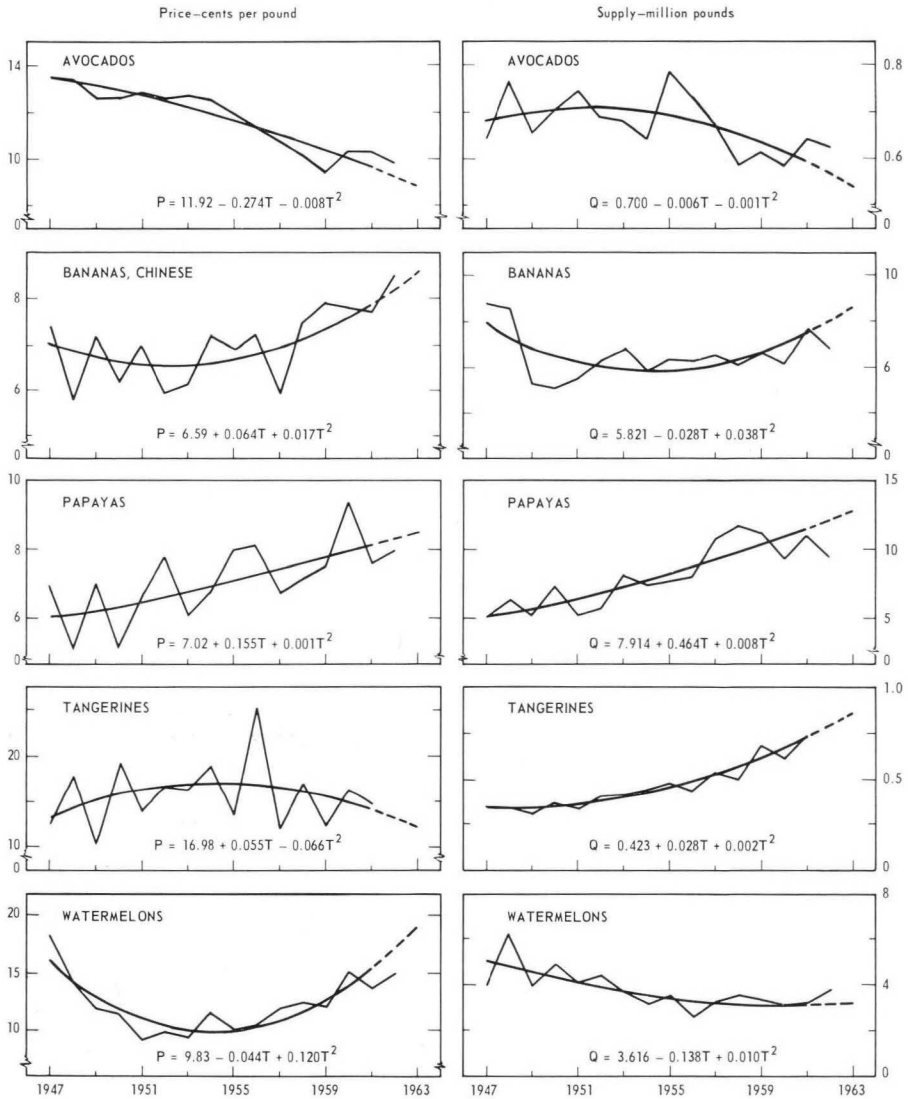
[4] In this discussion the term "fruit" is used to include all melons and to exclude pineapples. As used in Hawaii, "diversified crops" refers to all crops other than pineapple and sugar cane.

[5] Exports for fruits other than canned pineapple and pineapple juice averaged the following quantities in million pounds during 1957–61: 14.6, fresh pineapples; 2.2, fresh papayas; 1.2, canned nectars; and 0.9, other processed products.

FIGURE 1. Fruits: Honolulu wholesale price and supply, annual, 1947–61.



NOTE: In the trend equations T is time measured in years from 1954. Equations are fitted to 1947–61 data. For tangerines the data refer to marketing seasons beginning in the years indicated.

Based on Tables A-1 to A-14 and B-2.

2. Marketing the Five Fruits in Honolulu

Oahu production, arrivals from the Neighbor Islands, and mainland imports represent quite different proportions of Honolulu's supplies of each of the five fruits. Oahu produces about 80 percent of the bananas sold, 50 percent of the papayas, and only limited quantities of the avocados. The remaining supplies come from the other islands, principally Hawaii. Three-quarters of the tangerine supply originates on the island of Hawaii and one-quarter is imported from the Mainland. About 70 percent of the watermelons are grown on Oahu, 10 percent come from Neighbor Islands, and 20 percent are mainland imports.

Oahu's share of the papaya supply decreased from 99 to 50 percent of the total between 1947–51 and 1957–61. Tangerine imports declined from 65 to 25 percent of the total as production expanded on Hawaii. The relative importance of different supply sources changed much less for the other three fruits.

These five fruits represented almost half (48 percent) of the fresh fruits sold in Honolulu during 1957–61. Papaya, the most important individual fruit, was 49 percent of the five-fruit total. Percentages for the others were 30 for bananas, 15 for watermelons, and 3 each for tangerines and avocados.

Season prices and market supplies on the Honolulu wholesale market for 1947–61 are plotted in figure 1. Each set of data can be described quite satisfactorily by a parabolic trend. These trends, however, are quite dissimilar whether price or quantity data are compared.

The price trend rose throughout the period for bananas and papayas and declined for avocados. Prices decreased until the mid-1950's and then increased for watermelons. They followed the reverse pattern for tangerines.

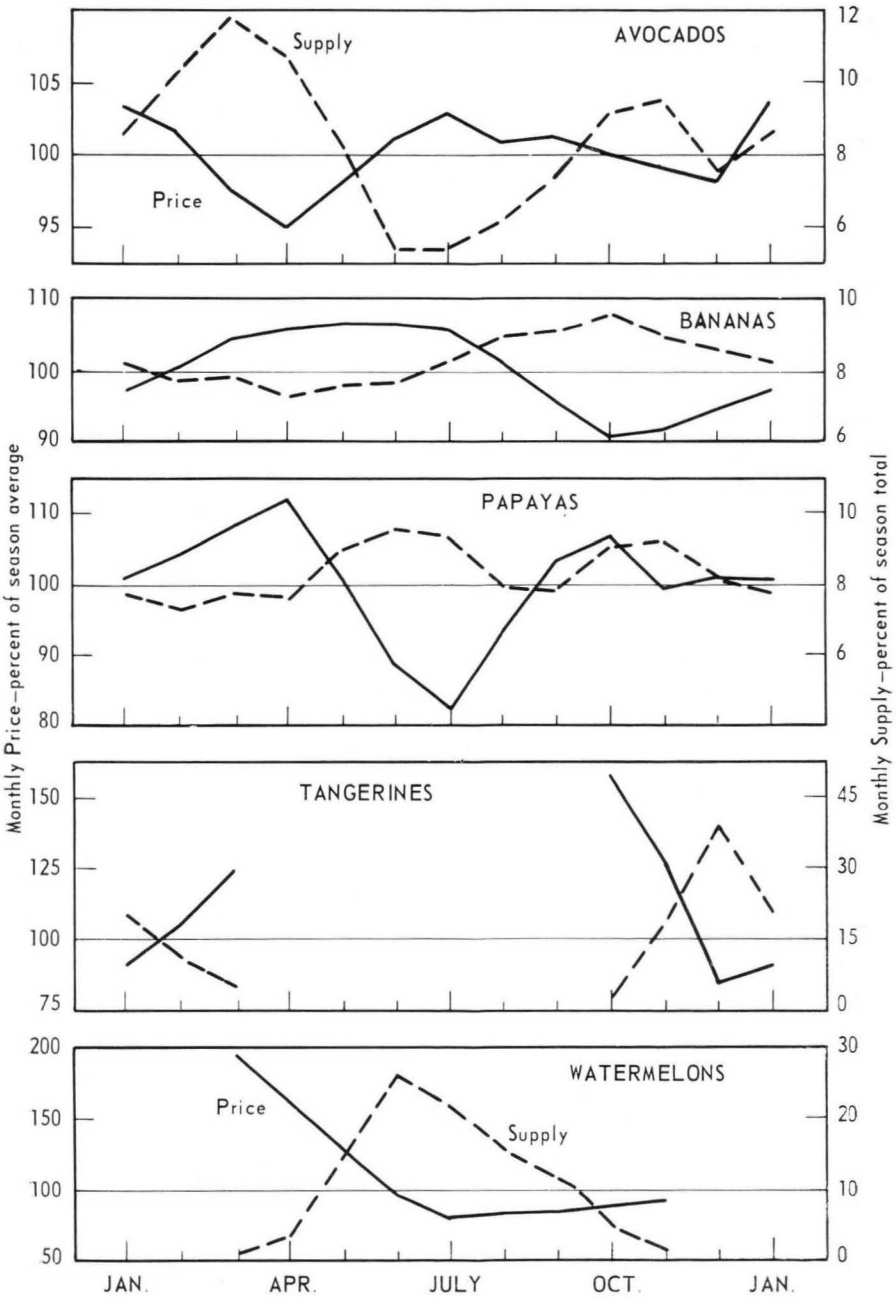
Honolulu's supply of papayas and tangerines increased sharply. The trend value of each in 1962 was almost two and one-half times that for 1947. Supplies of avocados and watermelons decreased, on a trend basis, throughout the period. For bananas the trend declined until about 1954 and then rose to slightly above its 1947 level in 1962.

Because of these trend differences, Honolulu supplies of papayas and tangerines almost doubled during the past 15 years—from 6.2 to 11.5 million pounds between 1947–51 and 1957–61—while the combined total for avocados, bananas, and watermelons decreased 11 percent to 10.6 million pounds. Thus, the proportion of the five-fruit total represented by papayas rose from 32 to 49 percent. During this period the supply of fruits other than the five studied continued at about 25 million pounds on the average.

Figure 2 shows the extent to which seasonal variations in wholesale prices are negatively correlated with monthly supply fluctuations. Watermelon prices begin high, decline rapidly until early summer as the season advances, and finally rise slightly again (or remain fairly level) while the last one-third or so of the crop is sold. Tangerine prices follow a similar pattern during the tangerine season. Seasonal price changes usually are much smaller for the other three fruits, especially for avocados.

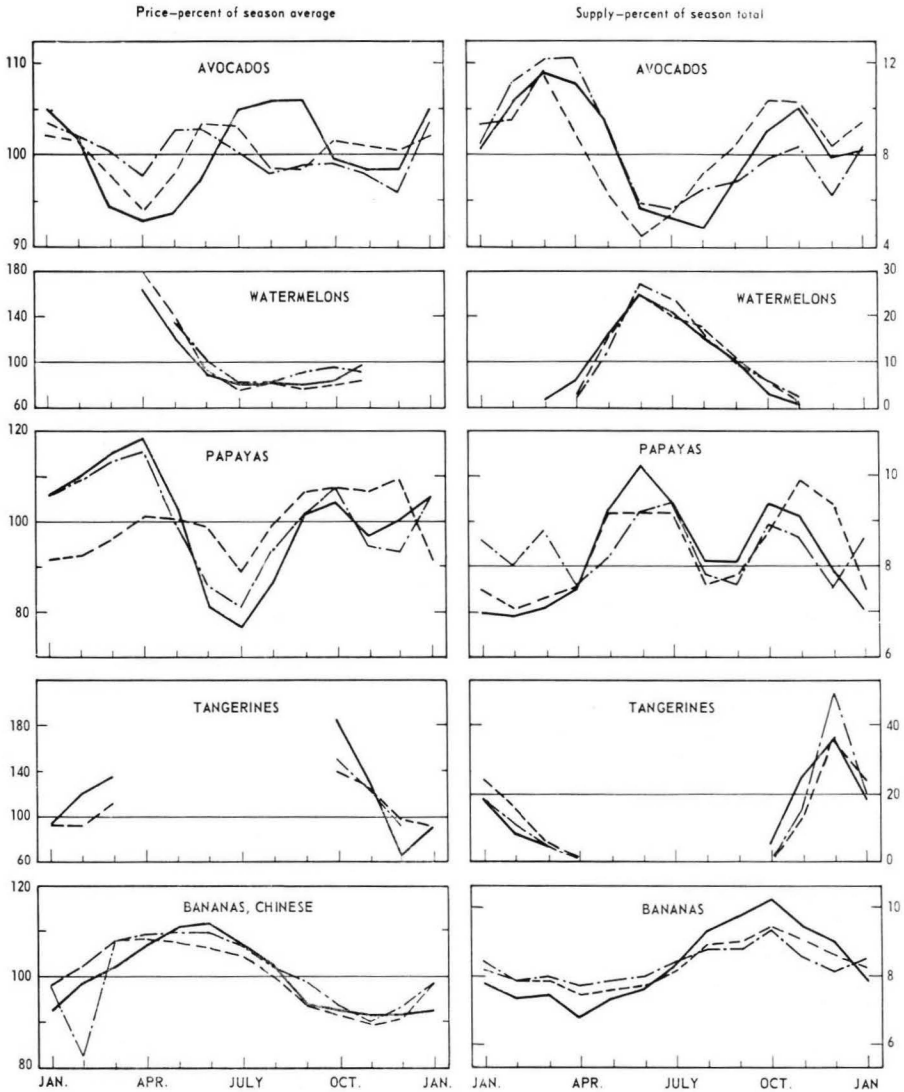
Seasonal price and quantity variations are compared in figure 3 for three periods —1947–51, 1952–56, and 1957–61. Although the relative importance of some months changed, the changes indicated generally are not large in comparison to

FIGURE 2. Fruits: Seasonal price and supply at Honolulu wholesale market, 1947–61 average.



Based on Tables A-1 to A-14.

FIGURE 3. Fruits: Honolulu wholesale price and supply, monthly, 1947–61.



NOTE: Five-year averages are shown as follows: —— 1947–51, – – – 1952–56, –·–·– 1957–61.
Based on Tables A-1 to A-14.

year-to-year fluctuations and they do not represent systematic shifts. Thus, it appears that seasonal variations in both monthly prices and monthly supply followed approximately the same patterns throughout the 1947–61 period.

3. The Problem of Temporal Demand Shifts

The price-quantity relation may not remain constant over time because many factors operate to determine the nature of demand prevailing at any given time. Their aggregate effect may change significantly so that the level or slope of the demand curve shifts temporally. These factors may be grouped into three categories according to the demand changes they induce.

Fluctuations in some factors lift and depress demand in a fairly regular fashion during the course of one year. For example, intraseasonal changes in weather conditions will affect demand to the extent that differences in product quality or in consumer preferences and eating habits result. Second, the population served by the Honolulu market changes seasonally due to changes in the number of tourists visiting Oahu and of residents away from the island on vacation. Seasonal changes in demand may arise from other factors, such as the number of lunches served in school cafeterias, the level of employment and income, the sale of substitute commodities, the quality of these products, and so on.

Variations in other factors, although also affecting demand regularly, have an appreciable impact only during longer periods. Usually their effect is cumulative. The population embraced by a market is likely to change in size and composition —and on a trend basis. Its purchasing power may change on a per capita basis and in terms of its distribution among consumer groups. Change may also occur in such other factors affecting prices as marketing methods, availability and prices of competing commodities, quality of the product under study and of its substitutes, and consumer tastes and preferences. Data tabulated in tables B-5 and B-7[6] relate to some factors which cause trend shifts in the demand for fresh fruits sold on the Honolulu market. These indicators (and other indices which might have been included) indicate that economic activity in Hawaii increased slowly prior to 1950 and then expanded substantially. For example, the State's civilian population and per capita income (in real terms) declined during the late 1940's and increased by one-third since 1950.

These first two groups of factors produce more or less regular shifts in demand which can be identified as seasonal variations and secular trends. Sometimes a relevant factor changes suddenly and produces an abrupt shift in demand. This point can be illustrated by again considering weather conditions. The weather may be so unusual during a particular season that the average quality of the crop is exceptionally good or poor. In another case, the demand shift induced may be of a more permanent nature arising from a drastic change in marketing methods, the introduction of a "new" product on a large scale, or a substantial permanent change in the supply of substitute products.

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[6] All tables with prefixes A or B are included in the Statistical Appendix.

B. METHOD OF ANALYSIS

The general methodology employed, the nature of the data used, and the rationale of the empirical approach followed are discussed below without elaborating on details which can be given more appropriately as the analysis is presented.

1. Procedure Followed

Conventional equations are used for expessing monthly price as a function of quantity and several shift variables. The underlying relations are assumed to be curvilinear. This approach leaves unanswered the problem of specifying the proper curve to be used. Insofar as possible, simple curves are fitted.[7] In essence, therefore, demand shifts are constrained to parallel movements, which may be either uniform or nonuniform.

In conformity with theory, price is expected to decline by progressively smaller amounts as quantity increases, when the influence of other factors is held constant. A parabola is one suitable way of describing this situation mathematically, providing it is convex to the origin and its minimum point is beyond the range of quantity values observed. Both conditions are met in these analyses and, therefore, the parabola is retained.

Curvilinearity also seems indicated for describing the "time" trend, which serves as a proxy for the combined influence of omitted annual variables. Since there is no theoretical base for specifying the form of this curvilinearity, a simple parabolic trend is used if a linear fit seems inappropriate, and higher degree terms are introduced if, and only if, a simple parabola also does not suffice to describe the nature of annual shifts.[8]

Ordinarily, monthly demand shifts cannot be described by very simple equations. The relation derived should be such that the seasonal pattern is closed in the sense that the level indicated for the end of the season equals that for the beginning. A sine curve and a cubic parabola are two functions which could be used to accomplish this end. Both, however, imply more uniformity in monthly changes than might be justified. Consequently, free-hand fits are used to represent monthly demand shifts. These are "forced" so that (1) the pattern is closed in the sense indicated and (2) the sum of shifts (positive and negative) totals exactly zero for the season. For tangerines and watermelons, which have marketing seasons of less than a year in duration, cubic functions serve well to describe the intraseasonal demand shift.

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[7] Of course, the simplest relationship is a linear function. Linear relations might be specified on the assumption that the degree of curvilinearity is slight within the range of observations used. This solution was not adopted here for two reasons. Preliminary explorations indicated that linearity would not suffice. Conceptually, it seems preferable to introduce a curvilinear relation and see how much curvilinearity is indicated and then to replace it with a linear function if that seems justified.

[8] Increasing the order of the fitted power series will, of course, reduce the standard error of estimate and increase the correlation coefficient. This point is discussed below when the results are presented.

All variables are expressed in original units. Since a large number of observations can be used there is no need to adjust the original data in an endeavor to reduce the number of variables. More importantly, there seems to be no rationale based on economic considerations for using deflators. The use of adjustors implies the existence of proportionality (or some other definite relation) between the deflator and the variable being adjusted. This procedure does not seem warranted here.[9]

Graphic correlation methods are used for deriving the demand relations prevailing at the Honolulu wholesale market. The advantages, as well as the drawbacks, of this approach are well known to research economists.[10] They need not be discussed here. A real effort was made to avoid the pitfalls. When the graphically determined relations can be represented reasonably accurately by linear, parabolic, or cubic equations, the graphic results are expressed by mathematical functions.

In one sense this procedure is quite flexible. Graphic determinations permit considerable leeway as to the relative importance attached to different observations (especially to the "unusual" ones), as to the forms of the functions, and so on. At the same time the procedure is fairly rigid—e.g., in the use of parabolic demand and trend functions and in specifying parallel demand shifts. Nevertheless, it serves as a convenient starting point. Although other functions may fit the data as well, or even better, there is no satisfactory way, now available, for choosing from the alternates available the particular function to be specified. This, of course, is not a peculiarity of this study, or of the graphic approach employed. It is an obstacle also encountered in making other price analyses and in using mathematical methods.

The period covered extends from January 1947 to December 1961. Earlier years are excluded from the analysis since they relate to a situation deemed unduly disturbed by war conditions and price control. Data for 1962, unavailable when the study was begun, became available subsequently. They were substituted into the formulations derived for 1947–61 to indicate how well these relations apply to 1962.

Initially, the study was carried out for 5-year periods. However, the results for the three short periods seemed consistent enough to warrant pooling all the data as a means for determining a better estimate of the trend effect. This step, involving a considerable amount of judgment, may be a real source of disagreement in interpreting results. It is readily admitted that by getting net relations separately for each 5-year period the results are different from those for all 15 years—and, incidentally, higher correlation coefficients are secured. If, however,

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[9] Deflation may introduce distortions and spuriousness into the relations to be described by the analysis. In any case, the use of adjusted and unadjusted data often gives substantially the same results. But even if not, there remains the problem of making certain that the difference is a real one and not merely the by-product of the adjustment method employed.

[10] One of the principal weaknesses is the temptation of introducing extra "wiggles" into the curves since these serve to increase the correlation coefficient.

the differences are not statistically significant, the relations for the totality of observations seem preferable.[11]

2. Hypothesis Tested

Monthly prices can be expressed as a function of quantity and of the shift variables in several ways.[12] Each separate formulation implies a specific hypothesis as to how the influences effect changes in the price level. The approach followed here consists of treating all monthly observations as an entirety, using a generalized formulation, and determining whether systematic changes in the regression lines are present. Shifts in the net price-quantity relation are secured by introducing "month" as a separate independent variable. The equation might be of the form:

$$P = f(Q) + g(M) + h(X_1, X_2, \ldots),^{13}$$

where P, Q, and M denote, respectively, monthly price, monthly quantity, and month of the season, and X_1, X_2, . . . represent other shift variables.

This equation restricts demand shifts to a well-defined, smooth pattern. The view that the underlying relation can be so described is defensible if the forces producing the shifts may be assumed not to change the magnitude of their influence abruptly. This assumption is made here.

3. Variables Used

Price is taken as the dependent variable for two main reasons. The empirical study is designed to "explain" fluctuations in wholesale prices by indicating the average or expected price corresponding to any set of values assigned to quantity and the other independent variables. This does not imply that causation necessarily flows from quantity to price rather than conversely. An appeal to the market structure, however, suggests that a plausible argument can be advanced for this type of cause-and-effect connection since wholesale prices are dependent upon the quantity offered for sale instead of the reverse. But even more importantly, reliance is placed on the statistical argument that errors of measurement should be concentrated in the dependent variable. Apparently such errors are relatively larger for price than for quantity in the case of fresh fruits marketed in Honolulu.

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[11] There are no statistical procedures for testing the significance of such discrepancies. Hence, the determination rests on subjective judgment.

[12] See Note 1, Methodology Appendix, for a discussion.

[13] This exposition is intended merely to indicate the procedure. Of course, the data used for fitting the equation may be either in actual values, their logarithms, or some deflated values. The equation set up may be arithmetic or it may represent a more complex relation secured by introducing curvilinearity and various joint effects.

"Month" and "year" are retained as shift variables in each final equation. They serve as proxies for the combined effect of all omitted factors which produce seasonal and trend shifts in demand. Use of these temporal variables is necessary because the study aims to determine the extent to which the demand functions change during the season and on a trend basis. They do give significant results.

No direct allowance is made for consumer purchasing power, primarily because data on economic activity in Hawaii are not available in the detail desired. Rather than using fragmentary information or data relating to the Mainland, it was decided to omit this factor. This means that the "income" effect is reflected by the evolutionary changes included under "year." This procedure, although contrary to that often adopted, seems justified. The principal reason for this view is that income in Hawaii, particularly when expressed in constant dollars, changed less sharply during recent years than is usually assumed.

4. Nature of the Price and Quantity Data

The series used for determining price-quantity relations are the monthly data on wholesale prices and market supplies for fresh sales at the Honolulu wholesale market. Neither series is entirely satisfactory since the data contain measurement errors which are not entirely representative of prices and quantities of fresh fruit sold for civilian use. However, these data are sufficiently accurate and representative to yield acceptable results. Their limitations and usefulness are indicated by the following description.

Wholesale prices for fresh fruits and vegetables are collected twice weekly (on Tuesday and Thursday) by the Federal-State Market News Service. The quotations are determined subjectively by interviewing a cross section of wholesalers, and relate to the portion of the supply grown within the State. Usually, these quotations are expressed as ranges "for stocks of generally good quality in trucklot or part trucklot quantities sold to retailers and restaurants by wholesalers or producers."[14] A simple average of the midpoints of these ranges for the Tuesdays and Thursdays of a calendar month is reported as the price for that month.

Price quotations for individual days are not substantiated in any way. The midpoint of the quoted range may, of course, differ from the average that would be determined (even for a specified grade) from actual sales records. Discrepancies of 5 to 10 percent or more might occur fairly frequently. The averaging technique used for determining monthly prices tends to give an upward bias because price and quantity are negatively correlated. This bias may be substantial during months in which prices vary considerably, as is likely when supplies do not move to market at a reasonably uniform rate.[15] The price is for a single

[14] Prices refer to Hawaii No. 1 grade for avocados and papayas and to "generally good quality" stock for bananas, tangerines, and watermelons.

[15] Although data on intraseasonal transactions are not available, an indication of the importance of this bias can be gotten by comparing reported annual prices (simple averages of monthly prices) with averages secured by using market supply as weights. For tangerines, an extreme case, the simple and weighted averages are 15.5 and 13.6 in 1960, and 22.7 and 16.8 in 1961. For watermelons they are 15.0 and 13.7 in 1960, and 14.7 and 12.2 in 1961.

designated grade. It is unrepresentative of price for all sales of a commodity when the quality composition of sales changes markedly during the season or from one year to the next. Such quality changes occur fairly frequently.

Honolulu market supply is the sum of unloads (from the Neighbor Islands and areas outside the State) and of estimated marketings from Oahu production. These data exclude direct imports made by the Armed Forces but include military purchases from local dealers (used by the Armed Forces or sold in their commissary stores), quantities shipped from Honolulu (to other islands and to the Mainland), and small amounts entering processing outlets.

Measurement errors in the quantity data arise in two principal ways. Standard conversion factors are used in deriving the poundage equivalents of unloads received at Honolulu. Actually the net weight of containers varies substantially, especially for supplies coming from sources within the State.

Second, marketings from Oahu production, which consist of truck receipts to wholesalers and estimates of direct sales by producers to retailers, are subject to greater measurement errors. The part represented by direct sales is computed as a specified percentage of the estimated monthly production. This percentage is selected after interviewing producers and is not substantiated by sales records. Even if this procedure gives fairly accurate annual totals, it may result in substantial errors for monthly allocations. The importance of measurement errors arising from estimating Oahu marketings is correlated directly with the proportion of the total market supply represented by direct sales.

When used in an analysis directed toward deriving demand for monthly movement into civilian consumption, as is done here, the quantity data have additional limitations. Since they refer to receipts, actual sales are reflected accurately only if month-end stocks in wholesalers' hands do not change. Since such inventories for the fruits considered here are small, relative to monthly sales, the supply data are reasonably good indicators of actual sales. These sales, however, also include military purchases from local wholesalers which are substantial for some fresh fruits and vegetables. Even this difficulty would not be a serious one if the relative importance of sales to the Armed Forces remained constant, or even approximately so. Such, however, is not the case. Military purchases vary considerably over time—both seasonally and annually.

Information on military purchases is not available in sufficient detail to permit adjusting the reported supply data in a manner yielding better estimates of monthly movement into civilian consumption during 1947–61. The fragmentary information that can be gathered indicates the magnitude and regularity of military purchases—summarized in tables 1 and 2. These data show that 1962 military requirements for four fruits and seven vegetables varied widely as to the proportion of the market supply represented and had fairly large monthly fluctuations. But of even more relevance is the second set of data which indicates that actual purchases during a 7-year period apparently fluctuated even more than requirements.

5. Rationale of the Empirical Approach

The problem considered is one of describing the demand function facing sellers at the Honolulu wholesale market. If annual data are used, the resulting

TABLE 1. U.S. Armed Forces requirements for certain fresh fruits and vegetables in Honolulu, Hawaii, 1962

COMMODITY	LOW MONTH	HIGH MONTH	AVERAGE MONTH	STANDARD DERIVATION	COEFFICIENT OF VARIATION	PROPORTION OF SUPPLY[a]
	1,000 pounds				*percent*	
Pineapple	35.8	55.8	46.2	6.18	13.4	NA
Bananas	30.0	61.7	41.4	8.97	21.7	7.4
Papayas	5.1	18.8	10.5	4.54	43.3	1.4
Avocados	3.8	7.7	6.2	1.05	17.0	11.4
Four fruits	74.7[b]	143.3[b]	104.3	18.55	17.8	4.2[c]
Lettuce	76.5	104.8	89.1	8.23	9.2	16.6
Tomatoes	50.5	80.8	64.0	8.18	12.8	11.5
Cabbage, head	38.3	65.2	53.0	8.41	15.9	8.7
Onions, dry	25.9	50.5	40.6	7.56	18.6	6.7
Celery	26.8	43.4	34.9	5.98	17.1	13.5
Carrots	21.8	39.0	29.0	5.74	19.8	10.7
Cucumbers	13.6	30.0	23.9	4.07	17.0	9.5
Seven vegetables	270.2[b]	400.7[b]	334.5	42.42	12.7	10.8

[a] Military requirements for 1962 divided by total supply on the Honolulu wholesale market, expressed as percentages. Not available for pineapple.

[b] The "low" and "high" months are those with the smallest and largest military requirements for the four fruits and the seven vegetables and not sums of smallest and largest quantities for individual items.

[c] Based on totals for three fruits (excluding pineapple).

Source: Based on information from Hawaii Crop and Livestock Reporting Service, *Hawaii Agricultural Production,* issues for November 1961 and February, May, and August 1962.

TABLE 2. Navy purchases of certain fresh fruits and vegetables from Honolulu wholesalers, 1953–59

COMMODITY[a]	LOW YEAR	HIGH YEAR	AVERAGE YEAR	STANDARD DERIVATION	COEFFICIENT OF VARIATION	PROPORTION OF SUPPLY[b]
	1,000 pounds				*percent*	
Pineapple	363	464	402.7	29.8	7.4	NA
Bananas	94	298	166.6	59.4	35.7	2.6
Papayas	59	93	72.9	12.5	17.1	0.8
Avocados	30	87	60.1	18.7	31.0	8.9
Tangerines	4	25	10.6	6.6	62.7	2.1
Other citrus	3	1,264	654.7	489.6	74.8	5.4
Pears	0	123	93.1	39.4	42.3	6.2
Other fruits	0	128	85.3	42.2	49.5	0.9
Watermelons	0	241	147.4	71.2	48.3	4.5
Other melons	0	180	108.1	56.6	52.4	8.5
Fruits and melons	642[c]	2,511[c]	1,830.1	616.7	33.7	4.1
Lettuce	237	647	450.0	126.8	28.2	8.8
Tomatoes	344	745	531.3	138.6	26.1	8.7
Cabbage, head	239	575	435.6	111.2	25.5	6.8
Onions, dry	140	358	257.9	78.3	30.4	3.8
Celery	23	514	355.0	157.8	44.4	11.2
Carrots	119	246	159.3	53.8	33.8	5.1
Cucumbers	107	201	155.0	33.4	21.5	5.7
Seven vegetables	1,323[c]	3,264[c]	2,344.1	633.9	27.0	7.0
Other vegetables	335	606	494.0	82.8	16.8	3.2
Potatoes	3	2,899	2,042.3	950.4	46.5	9.1

[a] The vegetables listed are the seven for which Navy purchases averaged over 120,000 pounds annually.

[b] Navy purchases divided by total supply on the Honolulu wholesale market, expressed as percentages. Not available for pineapple.

[c] The "low" and "high" years are those with the smallest and largest purchases of all items included and not sums of smallest and largest quantities for individual items.

Source: Based on unpublished data.

analyses may not reflect proper price-quantity relations for particular periods within the year since averages of the year's ups and downs are indicated. Using monthly data has several advantages. It is possible to estimate the nature and magnitude of intraseasonal shifts in demand. By accumulating 12 times faster, a large sample can be secured within a short period of time and before underlying supply-and-demand conditions change drastically. Observations for most variables cover a much larger range of values. Hence, it becomes possible to introduce more shift variables into the analysis and to fit the equations more accurately over a greater range of values for the independent variables.

This possibility of introducing more independent variables into the equations emphasizes two problems which may be indicated by questions. Are demands for successive months interrelated in the sense that prices are related to purchases in earlier (and later) months as well as to those of the current month? To what extent does one fruit substitute for another (or several others) at the retail level?

Answers to these questions must be sought by a trial-and-error method since there is no completely satisfactory *a priori* basis for specifying a better procedure. Attempts were made to measure the price effect of the prior month's supply and of the supply of competing fruits. The results obtained were not very satisfactory. They are discussed in the next section when the findings are presented.

Another serious difficulty remains. Several theoretically independent variables tend to move together. Because of this multicollinearity, it may be difficult to indicate very exactly how much of the price fluctuation is due to variations in purchases and how much to changes in food prices. Nevertheless, we can obtain estimates of the likely range within which values of the structural parameters of the demand equation lie. The derived price-quantity relations do relate to the demand side of the market and give considerable insight into how the pricing mechanism operates. Also they can offer some guidance about the immediate future under specified conditions beyond merely supplying estimators for the statistician's use in making predictions.

This empirical study is designed to derive by statistical means *ex post* demand functions expressing how average prices and quantities were related during a particular past period after allowing for the influence of changes in such other variables as are introduced into the analysis. It assumes that the unknown historical functions can be approximated by more or less simple equations obtained empirically from an analysis of the available statistical data. Specifically, this implies that:

1. A routine of demand exists so that the relations remain stable instead of being unduly disturbed by changes in omitted factors.
2. This routine can be revealed because the available observations are numerous enough to give a series of equilibrium points.
3. The major shift variables are measurable and included.
4. An *a priori* basis exists for assigning expectations as to signs and relative magnitudes for the parameters of the expected relations.
5. Adequate methods can be prescribed for testing the hypotheses.

These assumptions are fulfilled only partially by this investigation.[16] However, the procedure used is no more restrictive in terms of assumptions imposed than alternative methods available for approximating the relations among prices and purchases of fruits.

A related question may be raised: "Is it possible, by statistical analysis of data not experimentally controlled, to derive a demand function at one stage in the marketing process without taking into account the relations prevailing at other marketing levels?" It can be argued that the forces operative at the various levels are definitely interrelated and that the wholesale market occupies a central position in the system used for marketing fresh vegetables in Honolulu.[17] If this view is accepted, the relation derived for the wholesale market can be used for approximating appropriate demand functions at retail and at the farm by making proper adjustments for the retailer's markup and for marketing costs incurred in moving supplies from the grower to the wholesaler.

C. RESULTS OBTAINED

Several formulations, expressing wholesale prices of each fruit as different functions of the independent variables, were fitted to the data. Generally, they gave equally good empirical fits, in the sense that values of the correlation coefficient were approximately equal for the different equations. Considerations of simplicity, economic theory, and the nature of the commodities served as guides in choosing the final functions.

The results reported here are those which express monthly wholesale prices as simple functions of supply and two temporal shift variables for each fruit. After the individual results are discussed they are compared and examined further.

1. Avocados

An adequate description of the price-quantity relation prevailing during 1947–61 is portrayed in the three panels of figure 4.[18] The relation includes major factors effecting changes in monthly wholesale prices on the Honolulu market. It does not contradict expectations as to direction of influence deduced from theory and acquaintance with the commodity and its marketing. This final relation may be written in equation form as follows:

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[16] See also Note 2, Methodology Appendix.

[17] Wholesalers buy produce merely as intermediary handlers for resale to retailers, who, in turn, distribute them to consumers. The price bids made by wholesalers represent their estimates of the retail price-quantity relation and of the retailer's markup. Wholesale demand is determined by the same forces, operating in approximately the same manner, as influence retail demand. Hence, the statistical derivation of the wholesale demand function can be attempted without specifying the forces involved at other points of the distributive system.

[18] On each chart (figures 4–8) the same price scale is used in the bottom two panels so that the relative importance of annual and seasonal shifts in demand can be compared easily. This same scale is used in the top panels of only two charts.

$$(1)\quad P = 13.41 - 3.00Q + 0.90Q^2 - 0.340T - 0.0132T^2 + 0.00231T^3 + g(M)$$

where P is monthly wholesale price in cents per pound,
Q is monthly wholesale market supply in 100,000 pounds,
T is "time" measured in years from 1954, and
g(M) is the monthly effect as shown in table 3.

Several facts of considerable interest and importance emerge. The net regression of price on quantity is negative in agreement with expectations. Although the curvature is slight, it is of the proper form. Hence, changes in quantity are inversely correlated with progressively smaller price changes as supply is increased. For example, changes of 10,000 pounds in monthly market supply are associated, on the average, with opposite changes of 0.26, 0.17, and 0.08 cent per pound, respectively, in the wholesale price when supply is at 25,000, 75,000, and 125,000 pounds.

The "time" trend is a cubic parabola with a maximum in 1949 and a minimum in 1963. Its steepest slope (negative) occurs in 1956.[19] This means that demand shifted downward during the entire study period except the first two years and will begin to shift upward after 1963. The annual change in the level of demand was —0.12, —0.36, and —0.25 cent per pound in 1950, 1955, and 1960, respectively, and may be expected to become +0.21 in 1965.[20]

Monthly demand shifts appear to be definite though not very large. The demand curve is at its highest level early in the year (February), declines for 4 or 5 months (to June or July), and then increases until the following February. The level of demand changes by 0.65 cent per pound, on the average, during the year. This is about equivalent to the price effect produced by changing monthly supply from 40,000 to 75,000 pounds (the range within which the middle two-thirds of the monthly observations fall) and is almost twice the largest annual shift in 1956, the year at which the trend is the steepest.

The portrayal of these average relations, as given in figure 4, can be explained simply. The demand curve, appearing in the top panel, shows the average relation between price and supply for the 1947–61 period, when the temporal influences of annual and monthly shifts are held constant at their respective averages. The bottom two panels indicate how much this historical demand curve shifted because of changes in factors causing annual and seasonal price variations. For example, a monthly supply of 30,000 pounds is associated, on the average, for the 1947–61 period, with a price of 12.6 cents; 100,000 pounds with 11.3 cents. The trend value for 1960 is —1.8 cents (middle panel of figure 4), which means that the entire demand curve is lowered by 1.8 cents from the average position for 1947–61. Allowances for monthly shifts (bottom panel) are interpreted similarly. Thus, the demand curve is raised by 0.4 cent for February, lowered by 0.2 cent for May, etc., relative to its average level for the year under consideration.

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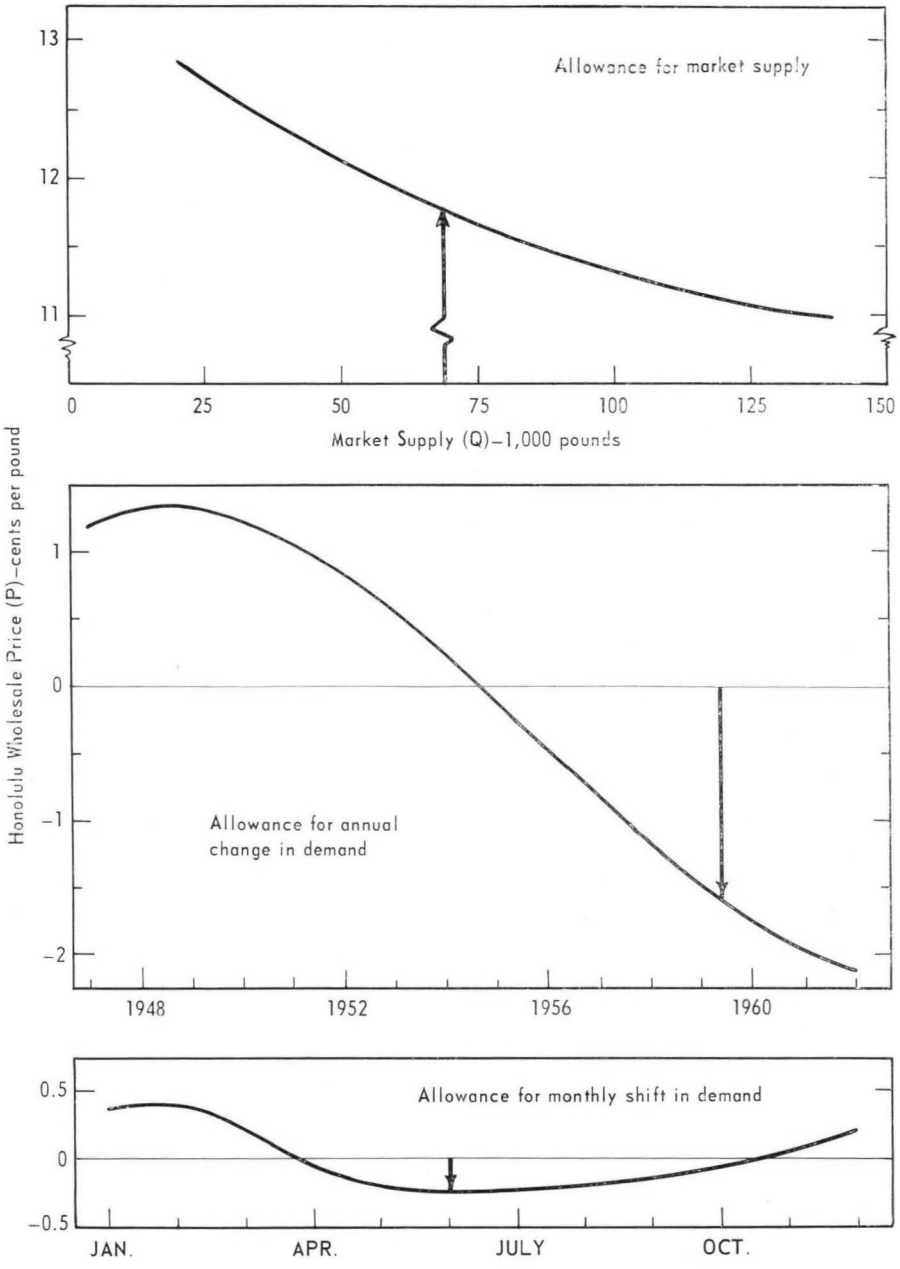
[19] The derivative of the trend, $Y = -0.340 - 0.0264T + 0.00693T^2$, is zero for $T = -5.35, +9.16$ years from July 1, 1954, i.e., at about February 1949 and August 1963, respectively. The second derivative is zero for $T = 1.90$ (June 1956).

[20] Values of first derivative with $T = -4, 1, 6, 11$.

FIGURE 4. Avocados: Estimated wholesale price with variations in supply, year, and month, 1947–61.



Based on Equation (1) and Table 3.

TABLE 3. Fruits: Results for regression analysis of monthly data, 1947–61

ITEM	AVOCADOS	BANANAS	PAPAYAS	TANGERINES	WATERMELONS	ITEM	AVOCADOS	BANANAS	PAPAYAS	TANGERINES	WATERMELONS
Coefficients[a]						*Annual shift*[b]					
A	13.41	10.63	13.29	25.40	14.33	1947	1.19	0.85	− 2.73	− 0.92	6.0
B	− 3.00	− 0.76	− 1.10	− 2.50	− 0.80	1948	1.31	.26	− 2.80	− .63	3.0
C	0.90	0.02	0.02	0.20	0.02	1949	1.33	− .19	− 2.65	− .39	.4
						1950	1.26	− .50	− 2.36	− .17	− .8
Monthly shift[c]						1951	1.08	− .68	− 1.93	0	− 1.3
January	.37	− .26	− .42	− 3.40		1952	.85	− .76	− 1.40	.15	− 1.5
February	.40	− .09	− .33	− 2.25		1953	.57	− .74	− .80	.26	− 1.48
March	.20	.08	.18	1.30		1954	.25	− .64	− .15	.33	− 1.36
April	− .08	.21	.47		5.45	1955	− .10	− .47	.52	.36	− 1.20
May	− .21	.30	.50		3.20	1956	− .47	− .24	1.17	.37	− 1.00
June	− .25	.34	− .02		1.35	1957	− .83	.02	1.78	.33	− .75
July	− .25	.31	− .55		− .20	1958	− 1.18	.32	2.32	.27	− .48
August	− .21	.18	− .83		− 1.40	1959	− 1.50	.62	2.76	.16	− .18
September	− .14	− .02	− .13		− 2.30	1960	− 1.77	.93	3.06	.03	.15
October	− .06	− .22	.75	5.90	− 2.90	1961	− 1.99	1.22	3.21	− .15	.5
November	.05	− .39	.50	.80	− 3.20	1962	− 2.13	1.48	3.18	− .35	.9
December	.18	− .44	− .12	− 2.35							
Price flexibility (λ)[d]						*Demand elasticity* ($1 \div \lambda$)[e]					
1947–51	.116	.429	.838	.073	.277	1947–51	8.638	2.329	1.193	13.782	3.616
1952–56	.094	.466	.752	.080	.271	1952–56	10.670	2.144	1.330	12.469	3.685
1957–61	.100	.369	.880	.119	.227	1957–61	9.964	2.710	1.136	8.412	4.409
Quarter 1[f]	.109	.338	.679	.088		Quarter 1[f]	9.209	2.956	1.474	11.408	
Quarter 2	.105	.310	.938		.223	Quarter 2	9.524	3.227	1.066		4.491
Quarter 3	.070	.393	.975		.326	Quarter 3	14.309	2.547	1.026		3.072
Quarter 4	.104	.439	.903	.142	.033	Quarter 4	9.596	2.278	1.107	7.045	29.929

[a] Equations (1) to (5) with trend and seasonal effects set at zero. These are of the form $P = A + BQ + CQ^2$, where P is price in cents per pound and Q is supply in 100,000 pounds.

(Footnotes continued on next page)

[b] These values, shown in middle panels of the charts, are determined from

$Y = 0.246 - 0.340T - 0.0132T^2 + 0.00231T^3$ for avocados

$Y = -0.638 + 0.138T + 0.0342T^2 - 0.00228T^3$ for bananas (Chinese)

$Y = -0.148 + 0.662T + 0.0079T^2 - 0.00484T^3$ for papayas

$Y = 0.327 + 0.055T - 0.0175T^2$ for tangerines

where T is time measured in years from 1954. A graphic determination (not shown) is used for watermelons. Adjustments are in cents per pound.

[c] Equations for the seasonal effects are

$Y = -2.362 - 2.130M + 1.052M^2 + 0.0212M^3$ for tangerines

$Y = -0.192 - 1.380M + 0.162M^2 - 0.00126M^3$ for watermelons

where M is time measured in months from December for tangerines and July for watermelons. Readings are taken from graphically determined curves for the other three fruits. Adjustments are in cents per pound.

[d] Computed by the formula $\lambda = -\overline{Q}P' \div \overline{P}$, where $\overline{Q}$ is the average monthly quantity for the indicated period, and the price, $\overline{P}$, and the derivative, P′, are obtained by substituting $\overline{Q}$ into the regression equation.

[e] An approximation obtained as the reciprocal of price flexibility, using unrounded data—see Note 3, Methodology Appendix.

[f] The quarters listed are for the 1957–61 period.

Note: Results for bananas are those obtained using price of Chinese bananas as the dependent variable. The equation for tangerines also includes a term reflecting the price effect of orange supplies—see Equation (5) in the text.

Source: Computed as indicated, using data in appendix tables.

2. Papayas

The relation between monthly wholesale prices for papayas on the Honolulu market and factors causing changes is shown in figure 5. The demand curve appearing in the top panel and allowances for temporal shifts (shown below) are interpreted in the same way as indicated for avocados. Average historical relations during 1947–61 are described by:

$$(2)\quad P = 13.29 - 1.10Q + 0.02Q^2 + 0.662T + 0.00792T^2 - 0.00484T^3 + g(M)$$

where the symbols have the meanings indicated for avocados.

The parabola describing the demand function is almost linear. Hence, the price reductions become only slightly smaller as progressively larger quantities are marketed. For example, changes of 100,000 pounds in monthly supply are associated, on the average, with opposite changes of 0.94, 0.78, and 0.62 cent per pound, respectively, in the wholesale price when supply is at 400,000, 800,000, and 1,200,000 pounds.

The minimum, inflexion, and maximum points on the cubic describing the "time" trend occur in 1948, 1956, and 1961, respectively. Annual increases in demand are about 0.37, 0.66, and 0.23 cent per pound for 1950, 1955, and 1960, respectively.

As the season advances the demand curve shifts up and down through two complete cycles. Maxima are reached in May and October and minima in January and August.[21] The level changes by 1.6 cents within the season. This change is large relative to annual shifts but not so large compared to price changes associated with changes in supply.

3. Bananas

Banana prices are reported for three varietal groups. Using the different price series for the dependent variable gives similar results for average historical relations during 1947–61.[22] The equation selected is the one with prices for Chinese bananas:

$$(3)\quad P = 10.63 - 0.76Q + 0.02Q^2 + 0.138T + 0.00342T^2 - 0.00228T^3 + g(M)$$

where the symbols have the meanings indicated above.

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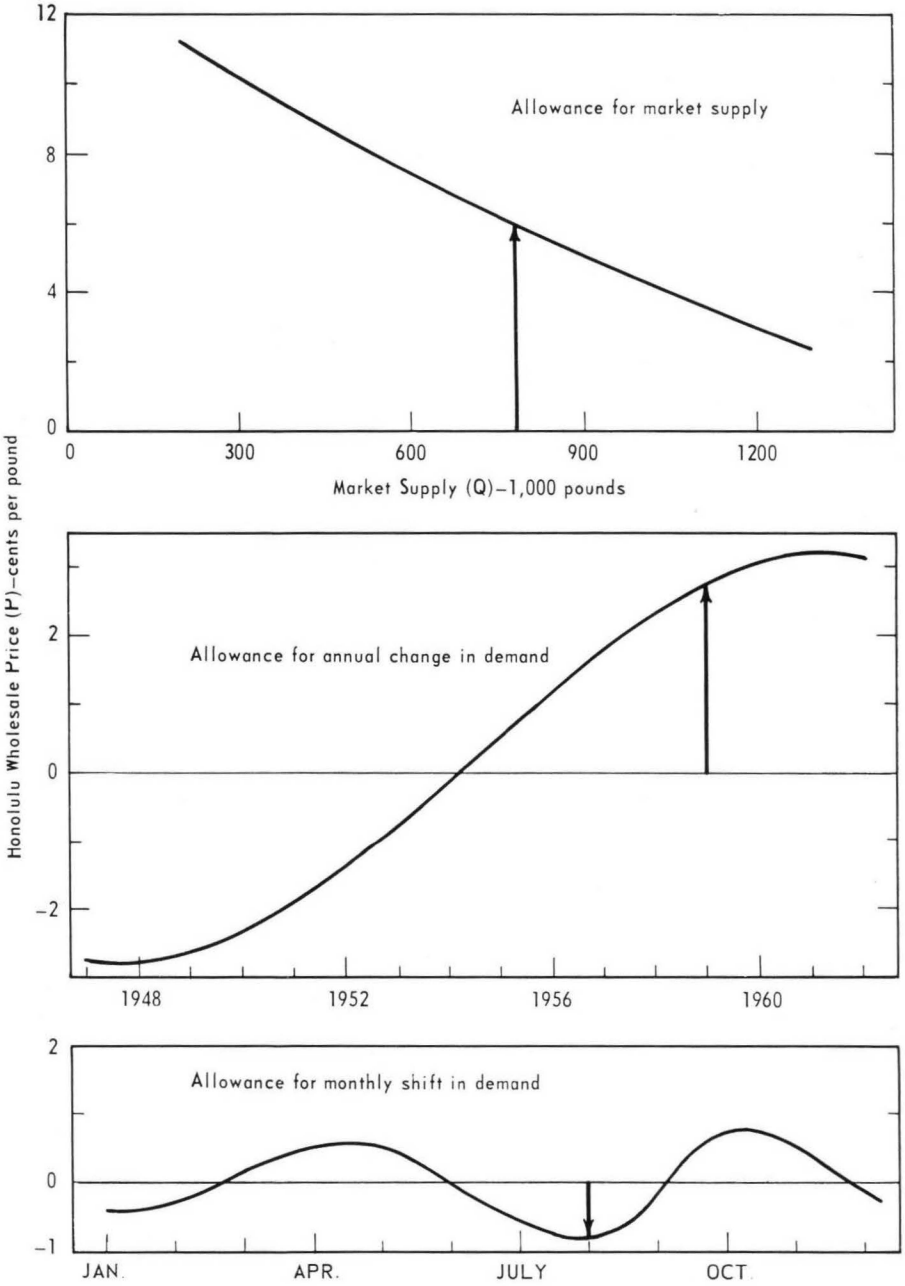
[21] Possibly this pattern is due to seasonal changes in the varietal composition of papayas marketed in Honolulu or to changes in the relative importance of different sources of supply. For example, the proportion coming from Oahu production varies from a high of about 60 percent in April or May to a low of 45 percent in December.

[22] The Bluefields variety represented a relatively small proportion (say 10–15 percent) of the banana supply in Honolulu until about 1959, the year the receipts from the Neighbor Islands (consisting largely of Bluefields bananas) began to increase rapidly. Chinese and Apple banana varieties have been of about equal importance, at least during recent years, in the total supply. The price series are highly correlated. Each of the three coefficients of correlation exceeds $R = 0.9$ when allowance is made for trend shifts in annual data.

FIGURE 5. Papayas: Estimated wholesale price with variations in supply, year, and month, 1947–61.



Based on Equation (2) and Table 3.

The demand function is almost linear (see figure 6). On the average, changes of 100,000 pounds in monthly supply are associated with opposite changes of 0.64, 0.52, and 0.40 cent per pound in the wholesale price when supply is at 300,000, 600,000, and 900,000 pounds. The parabola reaches a minimum at a supply of 1,900,000 pounds—a quantity twice the greatest supply available during any month of the past 15 years.

The "time" trend is a cubic parabola with minimum, inflexion, and maximum points at 1952, 1959, and 1966. Demand shifts in a regular fashion during the season, reaching a peak in June and a low point in December. These intraseasonal shifts (totalling 0.78 cent) are substantial compared to annual shifts and are equivalent to the price effect of a change of 150,000 pounds in monthly supply.

4. Watermelons

Although watermelons are on the market practically every month of the year, 48 percent of the season's supply is sold in June and July and 98 percent in the period April–November. Data for these 8 months are used in this analysis. Average relations for 1947–61 (figure 7) are described by:

$$(4)\quad P = 14.33 - 0.80Q + 0.02Q^2 - 1.380M + 0.162M^2 - 0.00126M^3 + f(T)$$

where M denotes time measured in months from July (midseason) and the other symbols have the meanings used above.

Temporal shifts in demand were substantial. Demand decreased 8.6 cents per pound, on the average, between April and November of each season. The annual level of demand declined sharply during the initial years of the period, reached a minimum in about 1952, and increased moderately thereafter at an annual average of almost 0.25 cent per pound.

The net price-quantity relation was almost linear. A change in supply from zero to one million pounds (a range including 93 percent of the monthly observations for April–November) corresponded to a price effect of 6.0 cents per pound —compared to an intraseasonal shift of 8.6 cents. Price changed by 0.7, 0.5, and 0.3 cent per pound, on the average, with an opposite change of 100,000 pounds in supply when supply was 250,000, 750,000, and 1,250,000 pounds.

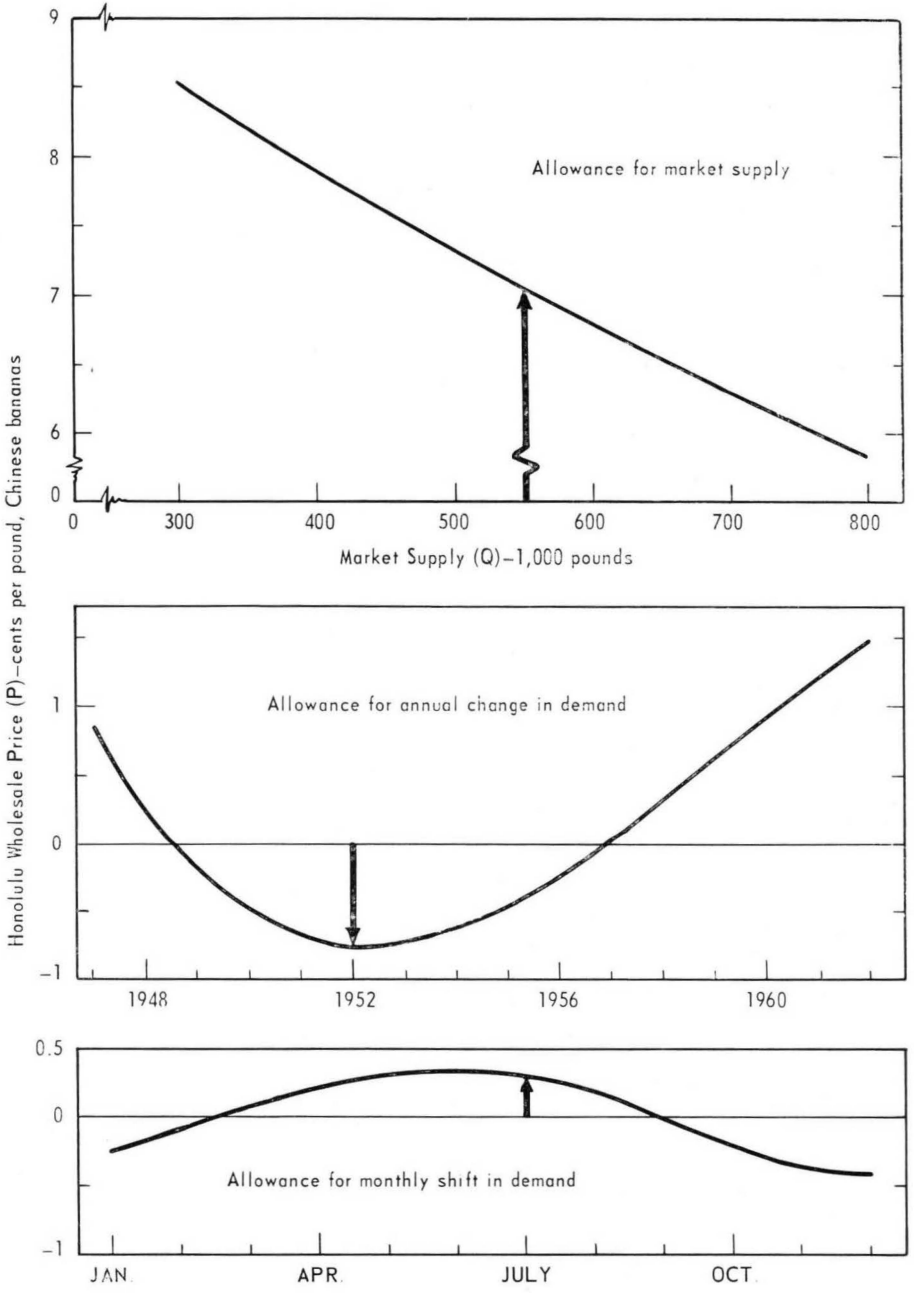
Introducing the supply of other melons as a separate independent variable changed the results of the analysis very little.[23] Its addition to the equation changed the results a little from those described by (4). The price effect is given by:

$$C = 0.68 - 0.70Q_1 + 0.07Q_1^2$$

where Q_1 is the monthly supply of other melons in 100,000 pounds. This parabola is almost horizontal over the range of observations ($Q_1 = 0$ to $Q_1 = 3.5$) and produces a relatively small price correction. The introduction of Q_1 modified the temporal shifts but not very much. The pattern of intraseasonal demand shifts

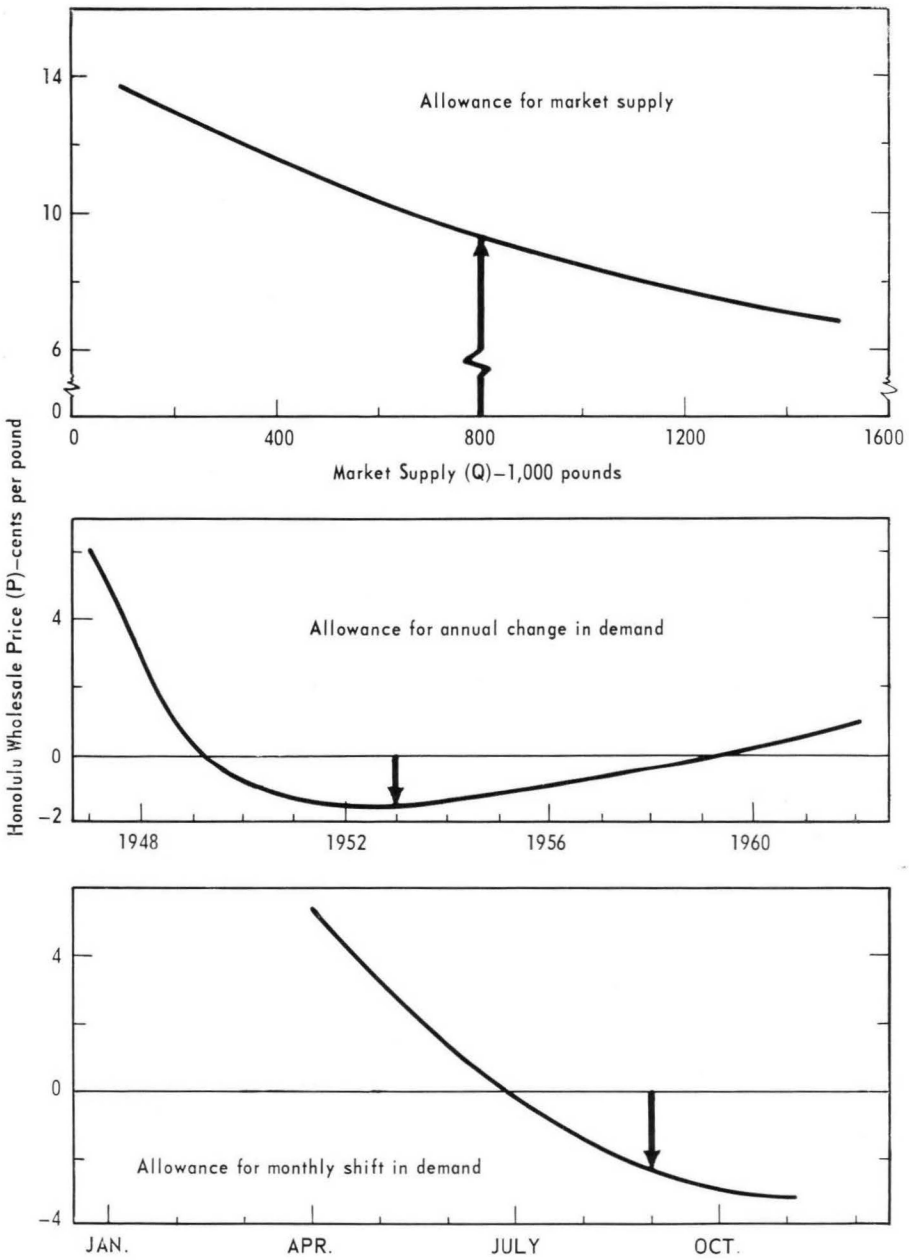
[23] During the bulk of the season watermelons are marketed about a month earlier than other melons. For example, 25 percent of the average season's supply for 1957–61 was sold by about May 8 for watermelons and June 10 for other melons, 50 percent by July 6 and August 9, respectively, and 75 percent by August 14 and September 8.

FIGURE 6. Bananas: Estimated wholesale price with variations in supply, year, and month, 1947–61.



Based on Equation (3) and Table 3.

FIGURE 7. Watermelons: Estimated wholesale price with variations in supply, year, and month, 1947–61.



Based on Equation (4) and Table 3.

became almost linear, with the total decrease from April to November remaining about equal to that given in table 3. The "time" trend was tilted slightly so that the initial decrease became a little steeper and the subsequent increase (following 1952) was somewhat less. These changes in intraseasonal and trend shifts did not alter the net price-quantity relation noticeably.

The use of other melons does not produce any particular improvement in providing a descriptive equation. Apparently, these melons are not very competitive with watermelons on the Honolulu market. Or if they are, their true relation is hidden by the correlation between the two supply series.

5. Tangerines

Generally, supplies of tangerines are small until about mid-November, reach a peak in December, and decrease rapidly to a relatively small volume by February or March. In this analysis the calendar year is replaced by the marketing season as the appropriate year interval. Observations are limited to a 6-month period, October–March, during which 98 percent of the season's supply moves into consumption.

Certain difficulties of analysis were encountered. For the initial years, prices are not available after December. Although this causes some lack in comparability with later years, the entire 1947–61 period was retained. The marketing season for several years is earlier or later than normal by 2 or 3 weeks. Comparing results obtained by using calendar months with those obtained by using adjusted seasonal months indicated that no particular gain is secured by such adjustments.[24] Introducing the prior month's supply as an additional variable merely resulted in reducing the regressional coefficient of price on current supply by about the amount obtained as the value of the new coefficient.

An attempt was made to introduce the supply of oranges as a separate variable. Although the descriptive equation is improved only by a small amount in terms of increasing the correlation coefficient, the factor is retained. Changes in orange supplies seem to have a substantial effect on tangerine prices over the range of observations.

The final equation describing average relations for 1947–61 is:

$$\bar{(5)}\quad P = 25.40 - 2.50Q + 0.20Q^2 - 0.90Q_1 + 0.025Q_1^2 + 0.055T - 0.0175T^2 - 2.130M + 1.052M^2 + 0.0212M^3$$

where M denotes time measured in months from December (midseason), Q_1 denotes the supply of oranges (in 100,000 pounds) and the other symbols have the meanings already indicated. The results appear in figure 8.

The "time" trend is curvilinear but relatively small in magnitude. Intraseasonal demand shifts are similar to those obtained for watermelons. Demand is high in October, declines sharply until January, and increases during the balance of the season. Annual demand shifts are very small.

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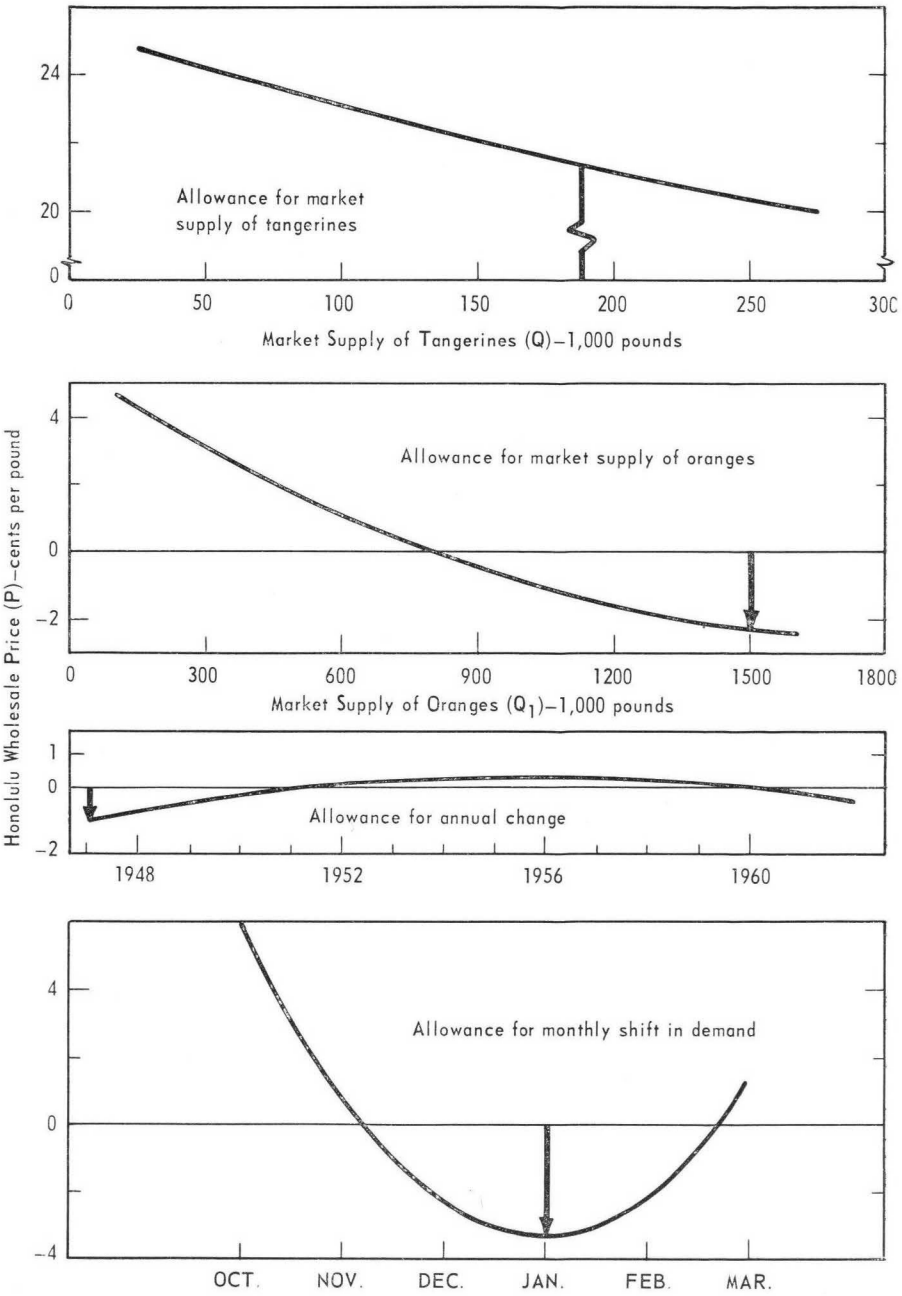
[24] For example, data for 1956–57 (a late season) were moved ahead 1 month—November price and quantity were assigned to October, those for December to November, etc. For an early season an opposite shift was made. The final results as presented omit these adjustments (attempted to improve comparability between observations) except the one for 1956–57.

FIGURE 8. Tangerines: Estimated wholesale price with variations in supply, year, and month, 1947–61.



Based on Equation (5) and Table 3.

The supply of oranges is inversely related to tangerine prices by a parabolic function which becomes approximately horizontal at its right-hand extremity. In fact, the data tend to force an upturn in this curve so that its minimum would occur within the range of observations encountered. Since such a result would run counter to expectations, a constraint was imposed so that the minimum does not take place for a supply of less than 1,800,000 pounds.

The net price-quantity relation is a parabola with only slight curvilinearity. A change in supply from zero to 200,000 pounds (a range including 88 percent of the monthly observations for October–March) corresponds to a price effect of 4.2 cents per pound, compared to an intraseasonal shift of 9.3 cents. Changes of 10,000 pounds in monthly supply are associated, on the average, with opposite price changes of 2.4, 2.1, and 1.8 cents per pound when supply is 25,000, 100,000, and 175,000 pounds.

6. Addition of 1962 Data

Data for 1962, unavailable when the analyses were derived, were substituted into the formulations derived for 1947–61. The monthly price estimates obtained for 1962 agree as closely with actual prices as those secured for the years covered by the analyses. The price residuals obtained for 1962 are included in the appendix tables along with those for earlier years.

Although the derived functions give good fits for 1947–61 and provide good price estimates for 1962, it should not be concluded that they will serve as adequate price estimators for many years into the future. With the passage of time, the regressions are likely to become less exact in describing actual relations. As data for additional years of the 1960's become available, the functions should be revised, as necessary, in order that they continue to yield good price forecasts.

Monthly price residuals for each fruit varied to about the same extent in 1962 as in preceding years.[25] The average residual was —1.21 for papayas and approximately zero for the other three fruits. Eleven of the 12 residuals for avocados and bananas and 7 of the 8 for watermelons had values less than two standard errors of estimate. Eleven of those for papayas were within this range from the average of all 12 (—1.21).

7. Comparative Summary

The final regression equations relate monthly prices by fairly simple functions to three factors: (1) monthly wholesale supply, (2) an annual "time" trend, and (3) an intraseasonal shift. The relations derived for 1947–61, as summarized in the top portion of table 3, do not contradict *a priori* expectations.

Each demand curve is approximated by a convex parabola which declines over the entire range of observations. It is somewhat more curvilinear for avocados than for the other four fruits. But even in this case the curvature is relatively small.

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[25] The ratios of the standard deviation of 1962 residuals to the standard errors for 1947–61 are 0.92, 0.83, 1.25, and 1.34, respectively, for avocados, bananas, papayas, and watermelons. Tangerines are omitted from this comparison since data for January–March 1963 are not yet published. Residuals for tangerine prices are —2.0, —7.5, and —0.8 for October, November, and December 1962 compared to a standard error of 4.05 for 1947–61.

The temporal changes in demand levels varied considerably in magnitude and pattern. Intraseasonal shifts averaged about 9.0 cents per pound for watermelons and tangerines compared to 0.7 to 1.6 cents for the other three fruits. The total change in the annual level during 1947–61 amounted to 7.5 cents per pound for watermelons, 6.0 cents for papayas, and 1.0 to 3.0 cents for the other fruits.

A definite trend for changes in the demand level was secured in each case. A parabolic trend (of small magnitude) sufficed for tangerines. The trends for avocados, bananas, and papayas were described well by cubic functions. Because of the initial sharp decline in demand, a more complex function was needed to approximate the trend for watermelons.

Intraseasonal shifts also showed definite and varied patterns. The demand functions for watermelons and tangerines decreased sharply as the season advanced (especially during early months) and then increased. For avocados and bananas the level of demand changed in a more or less regular fashion during the season, with a period of about 6 months between the high and low levels. A more complex pattern, including two complete cycles, seemed to be indicated for papayas.

An effort was made to determine the extent to which the price-quantity relations are affected by the prior month's sales of the given fruit and by the supply of selected other fruits which might be presumed to be competitive. These attempts were not very successful.

In each case, the use of the prior month's sales was unsuccessful in indicating any definite interrelation of temporal markets. Apparently, if successive time markets are interrelated (as might be suspected), the nature of that interdependence is more complex than the simple linear relation assumed or a month is too long an interval for revealing the interrelation that exists.

Using the orange supply improved the tangerine analysis. But no similar supply variable was uncovered for the other fruits. This does not mean that Hawaii-grown fruits do not compete with each other or with mainland fruits. The negative results secured in this study merely indicate that the particular "other" fruits selected and the simple relations used do not suffice in revealing whatever conditions of competition actually prevail.

Coefficients of price flexibility and their reciprocals for various subperiods during 1947–61 are tabulated in the bottom portion of table 3.[26] These values indicate that:

1. Demand elasticity declined from one 5-year period to the next for tangerines and remained fairly stable for the other four fruits.
2. Demand elasticity varied somewhat more on a seasonal basis, especially for watermelons during the fourth quarter.
3. Demand elasticity differed substantially among the fruits, being very high for avocados and tangerines and approximately 1 in value for papayas.

With monthly observations for 15 years, it is possible to make a careful study of the distribution of residuals. Residuals derived from the equations (given in

[26] A minus sign is introduced into the definition so that all coefficient values are positive. Values are computed at the centroids. In this summary discussion, reciprocals of price flexibility are called demand elasticity even though this is only an approximate relation. See Note 3, Methodology Appendix.

Appendix Tables B-8 to B-12) were plotted about the net regressions of price on supply, year, and month. These plots—not included here—do not suggest further adjustments in the regressions since the residuals do not fall into systematic patterns.

The Durbin-Watson Test is often used currently to determine whether successive values of the residuals are correlated serially. The calculated d′ and 4—d′ values are 2.20 and 1.80 for watermelons. Both lie above the upper limit of the Durbin-Watson tabulation, indicating there is no serial correlation of residuals. For avocados, bananas, papayas, and tangerines, however, the computed d′ values lie below the lower table values. Thus, the hypothesis of zero serial correlation in the residuals must be rejected for these four fruits and the interpretation of results needs to be modified accordingly.[27]

There remains the question of whether the pattern of intraseasonal shifts in demand has changed appreciably or remained reasonably constant during 1947–61. Examination of the residuals obtained fails to reveal any evidence suggesting a definite change except possibly in the case of tangerines. But even for this fruit, the evidence is not overwhelming and clear-cut. It seems (to the author) preferable to use the same adjustments for all years.

In fitting the functions, attention was not given exclusively to securing the descriptive relations which reduce residuals as much as possible.[28] Yet it is of interest to consider the goodness of fit. The coefficients of multiple correlation, R, obtained are:

Watermelons	0.947
Bananas	0.896
Avocados	0.868
Papayas	0.816
Tangerines	0.706

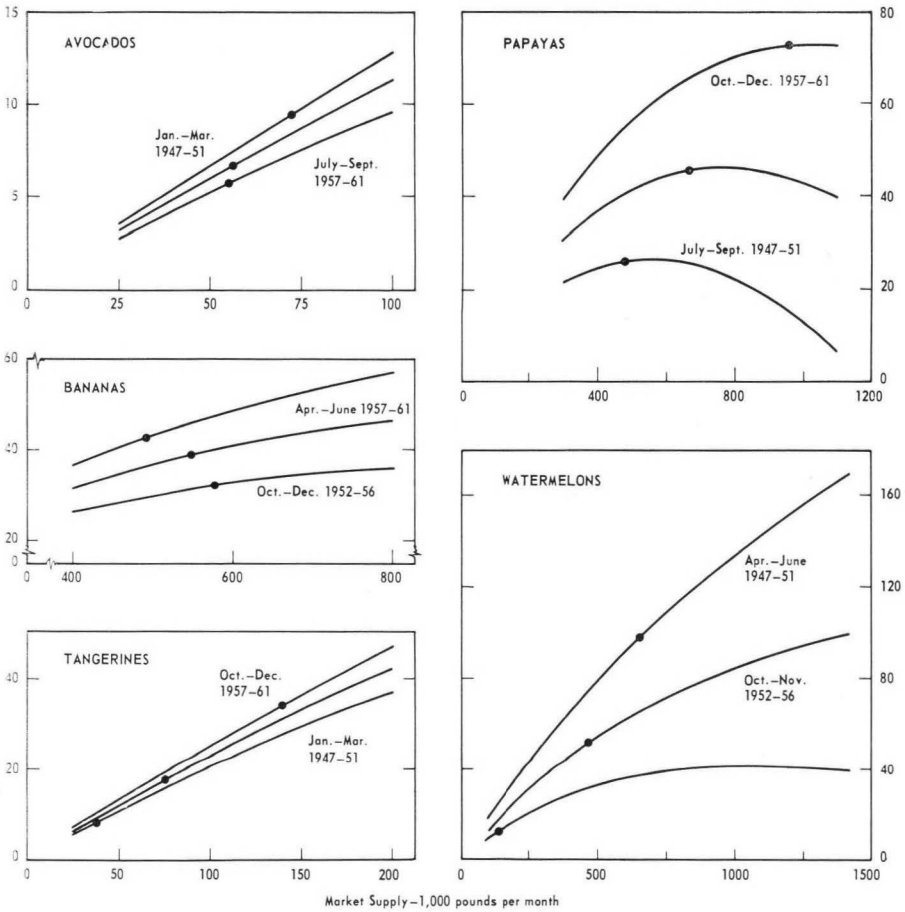
Thus, on the average, variations in market supply and temporal shifts in demand (monthly and annual) "explain" about 90 percent, R^2, of the variation in monthly wholesale prices of watermelons, 80 percent for bananas, 75 percent for avocados, 67 percent for papayas, and 50 percent for tangerines.

The regression equations can be used for deriving total returns curves corresponding to annual and seasonal effects held at any desired values. These are shown in figure 9 for three levels of demand: the 1947–61 average in comparison to the highest and lowest 5-year quarters—as identified for each fruit on the chart. Each curve is a cubic since it is based on a parabolic price-quantity relation. The curves appear to be very dissimilar, however, because only those

[27] Computed values of the regression coefficients are still unbiased estimates. Their standard errors, however, cannot be calculated without making some assumption about the magnitude and nature of the serial correlation in the population.

[28] For example, closer empirical fits can be secured for each fruit by making separate analyses for short periods. This "improvement" results because different trend and seasonal shifts are obtainable. However, average trend and seasonal movements applicable to 1947–61 as a whole were used because, by subjective determination, it appeared that trend and seasonal variations did not change sufficiently to warrant reflecting such changes.

FIGURE 9. Fruits: Total returns curves at three demand levels (in $1,000 per month).



NOTE: The middle curve is for 1947–61 average; the other two are for periods indicated. Each circle represents average monthly supply for the period.

Based on Equations (1) to (5).

portions are shown which correspond to the range in quantity variations experienced during 1947–61.[29]

For papayas, each total returns curve reached its maximum at about the midpoint of the relevant range of supply: Q = 550, 762, and 1,030 for the three periods indicated on the chart. This change in the position of the maximum reflected the upward shift in the demand function during 1947–61. Since, however, the maximum points on the curves are at monthly sales only slightly greater than the averages experienced, sales were made often when demand was inelastic.[30]

The total returns curves for the other four fruits are positive over the range of supply generally marketed, indicating that demand remains elastic at all demand levels. All the curves except those for watermelons appear to be linear. Actually each is concave.

D. IMPLICATIONS

This section considers the validity and limitations of the study, indicates the economic implications of the principal findings, and presents a few suggestions for further study. Only a general discussion of the major points is attempted.

1. Validity and Limitations of the Study

Demand is conceived as the empirically determined price-quantity function confronting sellers of fruit at the Honolulu wholesale market. The fundamental assumption underlying these empirical analyses (discussed in Section B-5) may be rephrased in condensed form: Supply is sufficiently routinized so that the unknown price-quantity relations remain relatively stable and may be approximated by simple empirical functions fitted to the observed data for the period studied. Hence, the basic problem becomes one of considering the type of relations postulated, the variables retained in the equations, the adequacy of the data, and the agreement of results with *a priori* expectations.

Simple functions are used for several reasons. Although these may be too simple to describe the underlying relations adequately, they do provide convenient first approximations over the range of observations used in the study. The results derived may give good forecasting equations even though they describe the true relations less satisfactorily. Finally, forecasts for the years immediately ahead should not require extrapolations beyond the range of observations used for deriving the regressions because monthly supply data are expected to fluctuate within the range established by the recent past.

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[29] Each total returns curve is of the form $TR = P \cdot Q = AQ + BQ^2 + CQ^3$. Its inflexion point is located at $Q = -B \div 3C$ for every level of demand. The inflexion points are at Q = 111, 1,267, 1,833, 425, and 1,333, respectively, for avocados, bananas, papayas, tangerines, and watermelons. Each occurs beyond the relevant range of Q.

[30] For example, 4 of the 15 monthly observations for July–September 1947–51 and 5 of those for October–December 1957–61 correspond to the inelastic portion of the demand curve.

The equations provide for parallel movements in the demand curves as shift variables assume different values. Possibly, the formulation should be generalized to permit changes in slopes also. This step was not taken only because it was assumed that such systematic rotations in the net regressions were less likely, over the range of observations, than parallel shifts.

It is recognized that price is determined by the combined influence of numerous factors. Section B-3 gives the reasons for including quantity, month, and year as the major independent variables in the final equations. By using only a few variables, biases may be introduced into the estimates of the regression coefficients since some omitted factors may exert important influences which are reflected indirectly through their correlation with the variables retained.

The data are not entirely satisfactory. Since both the price and supply series are subject to measurement errors, the estimates of regression and correlation coefficients do not possess the optimum properties specified by statistical theory and, therefore, may be biased. Secondly, some desired information is not available on the basis wanted. For example, weekly data may be necessary for adequately testing whether successive time markets are interdependent in the sense that sales in one period affect the level (or slope) of demand later during the season.

The hypothesis tested is a simple one. Yet the results derived agree completely with expectations—see Section C. Furthermore, the findings give considerable information about price determination on the Honolulu wholesale market. They are of importance to the fruit industry, produce handlers, and economists. Possibly of greatest significance is the nature and magnitude of the annual and seasonal shifts in demand, especially since these changes follow quite different patterns for the five fruits studied.

Corresponding demand schedules at the farm and retail levels can be approximated from the relations prevailing at the wholesale market. These give the bases for making various estimates of economic relations. For example, it becomes possible to estimate points of unit elasticity for farm demand and, hence, to determine maximum quantities to be marketed by farmers (as a group) in order to avoid reductions in total returns associated with increased sales.

Of particular concern to farmers and others is the extent to which the relations remain stable. The monthly and annual demand shifts derived relate to average composite influences exerted by numerous factors. Actually, the effect of some of the omitted variables may have changed abruptly since 1947 or may do so in the near future. The analyses shed no light on this problem. They do indicate, however, that roughly similar results are obtainable if the functions are fitted separately to 5-year subperiods. This evidence suggests that temporal patterns probably changed randomly rather than systematically during 1947–61. There is no basis for expecting this situation to be altered significantly in the next few years—nor, for that matter, for it to change very little.

2. Economic Implications of the Findings

An extensive restatement of the results does not appear warranted since the findings are discussed in considerable detail in the foregoing sections. The major conclusions are summarized on the first page of this report.

The results obtained relate to demand for fruit at the Honolulu wholesale market. They do not describe consumers' demand as reflected by their behavior at retail stores nor to price-quantity relations encountered by growers in disposing of their crops at the farm level. However, by making appropriate allowances for marketing margins, these other demands can be derived and their elasticities estimated.[31]

It may be assumed that for Hawaii-grown fruits marketed in Honolulu demand at the farm level is substantially below wholesale demand and approximately parallel to it.[32] If this situation prevails, as seems likely, demand is considerably less elastic at the farm than at the wholesale market. Hence, each increase in wholesale demand raises farm demand and increases its elasticity, while a decrease has the opposite effects on farm demand.

Wholesale demand for avocados, tangerines, and watermelons is sufficiently elastic so that farm demand is also elastic over the relevant range of supply for any reasonable allowance for commission selling charges and other marketing costs. A different situation exists for the other two fruits.

According to this analysis wholesale demand is least elastic in the fourth quarter of the year and has been rising (and so getting more elastic) since the early 1950's. Demand may have been low enough in 1950–54 so that farm demand was inelastic at least during October–December when supply was large. This result would have occurred if farm-wholesale marketing margins exceeded about 3.0 cents per pound. The same situation would have prevailed in 1957–61 if these charges rose to about 4.0 cents. Charges might have been even greater, which means that farm demand has been inelastic in some months during recent years.

In the case of papayas farm demand must have been inelastic quite often since wholesale demand was not very elastic—for example, quarterly values for 1957–61 were 1.47, 1.07, 1.03, and 1.11. Hence, the corresponding farm demand was inelastic, particularly after March, except when small quantities were marketed.[33] This means that during many months of each year net returns to growers would have been greater if smaller quantities had been sold.

How will demand elasticity change in the next few years? It is not easy to answer this question since probable changes in several factors must be considered. The trend shift in demand determined by this analysis indicates whether the wholesale demand curve is likely to rise or decline and by how much. Probable movements to higher or lower points on each demand curve are indicated by the supply trends shown in figure 1. Whether the spread between the wholesale and

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[31] The general relation between farm and wholesale elasticities is given in Note 4, Methodology Appendix.

[32] This assumption appears reasonable because of the nature of the farm-wholesale price spread. It consists of two parts which vary differently. The selling commission is a percentage of the wholesale price. Other costs incurred in moving farm supplies to market remain approximately constant during a given season regardless of the quantity sold (within broad limits), although they change from year to year.

[33] For example, farm demand (if it is approximately parallel to wholesale demand) was inelastic during April–December 1957–61 if marketing changes exceeded a 10 percent commission fee and 0.7 cent per pound for other marketing costs—or 15 percent plus 0.6 cent.

farm demand curves will increase or decrease depends upon likely changes in farm-wholesale marketing margins.

Specific estimates of probable changes in these factors will not be attempted here. The information presented in this report, however, does suggest that these influences will affect demand elasticities quite differently for the five fruits. For example, both bananas and tangerines have a fairly strong upward supply trend while their demand shifts seem to be in the opposite direction.

Papayas are of special interest since their farm demand already is inelastic at least during some months of most seasons. The upward shift in demand has just about reached its peak. If supply continues to increase, as is suggested by present data, demand elasticity will decrease. Farm demand, which is already inelastic when supply is large, particularly during April–December, will get even more inelastic.[34]

The above comparison of relative demand elasticities over the season also suggests the possibility of shifting planting times (to the extent that this is feasible) so that supplies arrive on the market in an altered seasonal distribution which will serve to enhance growers' returns. For example, demand for watermelons and tangerines is less elastic during the peak of the season than in earlier or later months. Actually this spreading out of supplies is occurring (see figure 3). For bananas, however, the major shift in seasonal distribution of supplies during recent years consisted of reduced sales in January–April and increased sales in September–December. This change may serve to decrease growers' returns.[35]

These fruits (and presumably vegetables and other crops that can use the land) have large differences in their supply trends, annual demand shifts, and demand elasticities. Thus, net farm returns per pound (or per acre) may change at substantially different rates. When these changes are compared with future changes in production and harvest costs, the relative profitability of these fruits will be altered. This result would be expected to lead to modifications in production from the patterns that might be expected otherwise.

3. Suggestions for Further Study

Although several aspects of demand were investigated, the foregoing discussion contains some gaps stemming from the fact that all relations having a significant bearing on the conclusions were not—in fact, could not—be studied. A few specific suggestions for additional investigations can be indicated.

The study of factors affecting fruit prices could be extended in several ways.

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[34] The supply trend fitted to 1947–61 data gives a poor fit for the most recent years. Possibly quantities marketed will level off or even decrease. Demand elasticity at wholesale (for annual data) declined from 1.33 in 1952–56 to 1.14 in 1957–61.

[35] Of course, numerous factors must be considered when plans are made for changing the seasonal planting of specific crops on individual farms. The farmer must give attention to relative yields and relative production and harvest costs during different months, to comparative trends in acreage and production, and to many cultural and environmental factors. These aspects of the problem are not considered here since this discussion is intended to be suggestive rather than inclusive.

Three are mentioned here. Since changes in a commodity's quality are expected to be correlated (positively) with price variations, an attempt might be made to obtain a reliable measure of quality. Data to test this hypothesis could be gotten by collecting information on quality for a few seasons. Secondly, a comprehensive treatment of complementarity relations is needed. The introduction of supplies of various fruits presumed to be competing on a more or less arbitrary basis, as was done here, gave unsatisfactory results. Possibly another attempt may have to be delayed until the theoretical basis for selecting competing products is more fully developed. Finally, the interdependence among temporal markets requires another examination. Possibly unsatisfactory results were obtained in this study largely because a month is too long a period. Weekly data should provide a better basis for determining whether prices are affected by both current supply and the supply available a short while previously. Weekly prices are now collected. If supply data were also reported on a weekly basis for a few years, the analysis could be made.

The regressions determined are average relations, of specified and relatively simple types, existing during 1947–61. This study did not attempt to determine whether these relations change much over time. Such an investigation should be made in order to improve the model's adequacy in explaining the complicated mechanism which operates to determine prices.

In brief, more attention should be given to specifying more suitable models, to collecting better data, and to developing more appropriate analytical techniques. Such improvements would lead to a more satisfactory evaluation of the economic problems facing the fruit industries in Hawaii. Of course, this is the situation encountered in practically all statistical investigations.

Measurements of supply response are not a part of this demand study. However, a satisfactory determination of long-run movements in prices requires examination of forces effecting variations in acreage and yield—the two determinants of production—and of those causing changes in imports of supplies from out-of-state sources.

The results show that demand curves for fruits shift their level substantially during the year and that these shifts are inversely correlated with seasonal changes in the quantities marketed. This means that when the demand shifts downward, sales generally occur at a point further to the right on the curve than is the case when the level increases. As a result, prices estimated from the regression equations vary considerably during the year. Price fluctuations are even greater at the farm level because farm-wholesale marketing margins remain relatively constant during a particular season.

This situation immediately suggests the possibility of individual farmers changing their production patterns to grow more during months when the demand curve is high. By doing so, however, they will encounter additional production problems which generally mean higher costs at this time of the year. There is very little information now available to indicate how production costs of these fruits (or other commodities, for that matter) vary over the season. Such production cost studies as well as additional demand analyses are needed to provide farmers with a better basis for making their decisions.

METHODOLOGY APPENDIX

Note 1. (Section B-2). The demand function may vary systematically over the course of a season. This variation may mean that for each subperiod the demand curve is at a different level, has a different slope, or assumes a different form (e.g., degree of curvilinearity). Such intraseasonal shifts may be introduced into the formulation in several ways. Two are mentioned here.

The following exposition assumes that monthly prices (P) are to be related to monthly quantity (Q), monthly index of consumer purchasing power (I), and month of the season (M). For convenience, the explanation is confined to arithmetic equations including only four variables. Of course, other subperiods (e.g., weeks or quarters) might have been used. The equations can be generalized by adding other shift variables and by introducing curvilinearity and joint effects.

If it is assumed that changes in the demand function should be left free to vary from month to month, the data for each month over a period of years are treated as a separate set of observations. A different equation is determined for each month. It is of the form:

$$P = A + BQ + CI.$$

Differences among the 12 equations represent changes in level and slope. These may be examined to determine the extent to which changes occur uniformly. Presumably, the differences are accepted as being significant if the equations display an "orderly fan-shaped arrangement" and are deemed insignificant if such systematic changes are lacking.[36]

A second approach, the one followed in this study (see Section B-2 above), uses all the monthly data as a single set of observations. It gives one regression equation including DM as an addition term:

$$P = A + BQ + CI + DM.$$

This procedure introduces a new variable (M) into the equation, systematizes the shifts, and determines the average monthly parallel shift.

In this form the second technique has obvious shortcomings relative to the first. It provides for uniform parallel shifts such that the level for the last month may be substantially above or below the first month's level. It does not allow for changes in the slope of the demand function. These disadvantages can be corrected by introducing additional terms. Nonuniform shifts in level (to any degree desired) can be secured by using a power series in M. Shifts in slope can be secured by adding various product terms. For example, parabolic changes in both level and slope are incorporated into the equation by changing it to the following form:

$$P = A + (B + B'M)Q + (C + C'M)I + (D + D'M)M.$$

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[36] In substance, this is the procedure used by G. L. Mehren and H. E. Erdman in their study of weekly prices of Louisiana strawberries. See "An Approach to the Determination of Intraseasonal Shifting of Demand," *Journal of Farm Economics,* May 1946, pp. 587–596. A similar approach is used by S. Hoos and R. E. Seltzer, "Lemons and Lemon Products: Changing Economic Relationships, 1951–1952," California Agr. Exp. Sta. Bull. 729 (1952), and S. Hoos and J. N. Boles, "Oranges and Orange Products: Changing Economic Relationships," California Agr. Exp. Sta. Bull. 731 (1953).

By using second and higher degree terms of M in the parentheses of this equation, the rates at which the regression coefficients change over the season may be increased or decreased gradually or altered in some other fashion.[37]

Note 2. (Section B-5). Conventional methods of classical regression analysis are used for determining average *ex post* relations which express prices as functions of quantities and selected shift variables. Not all of the conditions for a valid application of this technique are met by the data used. However, the procedure is no more restrictive in terms of assumptions imposed than alternate methods available for approximating relations among economic variables.

Severe criticism is sometimes levied at attempts to derive demand functions statistically. Three major objections are raised:

1. Time series data represent a unique sequence of observations which preclude a possibility of analysis.
2. Classical regression techniques do not provide an adequate method for estimating structure parameters.
3. Derived results describe historical relations and not theoretical demand functions.

Admittedly, these objections pose serious obstacles to any endeavor to empiricize the relations used by economists. The author's view is that the difficulties are not insurmountable and that the "givens" used by economic theorists to explain changes in prices and sales actually are "unknowns" to be determined. As already stated, the approach used for this study rests on the assumptions that:

1. Time series data constitute a set of drawings selected at random from imaginary infinite populations and the impossibility of repeated drawings is not construed as a serious difficulty.
2. Ordinary least-squares methods can be used to derive suitable relations among variables, even though time series data are used.
3. Derived results, although not necessarily descriptive of the theorist's concept of demand, can provide useful information about price behavior and can specify a rational basis for making predictions.

Note 3. (Section C-5). The notion of elasticity is used in economic theory to express the ratio in proportionate changes of two related variables. Specifically, elasticity of demand with respect to price is the proportionate change in demand relative to the associated proportionate change in price. This coefficient measures the responsiveness of the quantity taken to price changes and is computed (for some point on the demand function, say P_1, Q_1) from the formula

$$\eta = \frac{\text{relative change in } Q}{\text{relative change in } P} = \frac{\text{change in } Q \div Q_1}{\text{change in } P \div P_1} = \frac{P_1}{Q_1}\frac{dQ_1}{dP_1}, \text{ where } \frac{dQ_1}{dP_1}$$

is the slope of the demand curve at the point P_1, Q_1.

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[37] This is the procedure used by J. Foytik, "Characteristics of Demand for California Plums," *Hilgardia,* April 1951, pp. 407–527, and S. H. Sosnick, "Orderly Marketing for California Avocados," *Hilgardia,* December 1962, pp. 707–776.

To measure how responsive prices are to changes in sales (or quantity), the proportionate changes are compared in reverse order. This ratio, called the coefficient of price flexibility, is computed for point P_2, Q_2 by

$$\lambda = \frac{\text{relative change in P}}{\text{relative change in Q}} = \frac{Q_2}{P_2}\frac{dP_2}{dQ_2}, \text{ where } \frac{dP_2}{dQ_2}$$

is the curve's slope at the point P_2, Q_2.

Since price and quantity are negatively related, the two derivatives $\left(\frac{dQ_1}{dP_1} \text{ and } \frac{dP_2}{dQ_2}\right)$ are negative and all values determined from the above formulas are negative values. For this reason it is sometimes convenient to introduce a minus sign into the definitions and secure positive values for the coefficients. This is the procedure followed here. Hence, the formulas (at point P_i, Q_i) become

$$(1) \quad \eta = -\frac{P_i}{Q_i}\frac{dQ_i}{dP_i} \text{ and } \lambda = -\frac{Q_i}{P_i}\frac{dP_i}{dQ_i}.$$

These two values seem to be reciprocals. This, however, is not generally true. If both are computed from the same price-quantity relation, the derivatives (computed for any given point on the curve) are reciprocals of each other as are the values of elasticity and flexibility. Ordinarily, however, in statistical studies two different equations for the price-quantity relation are obtained according to whether price or quantity is taken as the dependent variable. The two derivatives are not reciprocals of each other and, consequently, η computed from one equation is not exactly equal to $1 \div \lambda$ computed from the other. The reciprocal of λ is a good approximation for η if price and quantity are highly correlated since in that case the two equations lie close to each other and the derivative of $P = F(Q)$ is almost equal to the reciprocal of the derivative of $Q = f(P)$.

This point can be illustrated by considering the simple case of linear functions derived statistically: $Q = A - BP$ and $P = a - bQ$, for which the derivatives are $-B$ and $-b$. The price associated with quantity Q_1 is $P_1 = (A - Q_1) \div B$ for the first equation and $P_2 = a - bQ_1$ for the second. (The two prices are equal only if Q_1 corresponds to the intersection of the equations.) Substituting into (1) gives

$$(2) \quad \eta = \frac{BP_1}{Q_1} = \frac{A - Q_1}{Q_1} = \frac{A}{Q_1} - 1 \text{ and } \frac{1}{\lambda} = \frac{P_2}{bQ_1} = \frac{a - bQ_1}{bQ_1} = \frac{a}{bQ_1} - 1.$$

These values are equal if and only if the correlation between price and quantity is perfect.[38] The values defined by (2) are positive for all values of Q between

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[38] The Q-intercepts are $Q = A$ and $Q = \frac{a}{b}$, respectively, for $Q = A - BP$ and $P = a - bQ$. If correlation is perfect, the lines represented by the two equations coincide and their intercepts are equal. Hence, $\eta = \frac{1}{\lambda}$. If, on the other hand, $\eta = \frac{1}{\lambda}$, then, from (2), $A = \frac{a}{b}$, so that their Q-intercepts are equal. But both equations also pass through the point represented by the means of P and Q. Hence, they define the same line and correlation is perfect.

zero and the quantity intercepts for $Q = A - BP$ and $P = a - bQ$. They are zero at the quantity intercepts and become infinite at $Q = O$.

Demand elasticity and price flexibility have the same values for different points on the net price-quantity equation only in special cases—e.g., with logarithmic functions. Generally, for increasing quantity the demand elasticity decreases and price flexibility increases. Hence, for most statistically derived functions, any number of values can be computed for either coefficient. A common practice is to calculate values at the centroid, i.e., at the means of the different variables.

Even this procedure, however, leaves some doubt because if curvilinear relations are established the means of the independent and dependent variables do not lie on the curve. The exact method followed here in computing price flexibility at the centroid is to use the formula

$\lambda = -\frac{\bar{Q}}{\bar{P}}\frac{\partial P}{\partial Q}$ where $\bar{Q}$ is the mean quantity, and $\bar{P}$ and the derivative are values at this point on the regression equation. A partial derivative is indicated since price is related to quantity and other independent variables. Values for λ are obtained for different time periods by using the appropriate average quantity and corresponding regression equation. Price flexibility for 1947–51, 1952–56, and 1957–61 is determined by starting with the average quantity for the 60 monthly observations for each subperiod and shifting the regression equation by the average trend change for the 5 years considered. Quarterly values for a subperiod are computed similarly from the average quantity for the 15 monthly observations for that quarter—e.g., January–March, 1957–61.

Note 4. (Section D-2). If it is assumed that the farm price is M cents (per pound) below a fraction, K, of the wholesale price, then the two demands and their first derivatives are related as follows:

$$P_F = KP_W - M \text{ and } \frac{dP_F}{dQ} = K\frac{dP_W}{dQ}.$$

Using the definition of the preceding note, demand elasticities at the farm and wholesale levels are given by

$$\eta_F = \frac{P_F}{Q} \div \frac{dP_F}{dQ} \text{ and } \eta_W = \frac{P_W}{Q} \div \frac{dP_W}{dQ}.$$

It then follows that

$$(1) \quad \eta_F = \frac{KP_W - M}{Q} \div K\frac{dP_W}{dQ} = \eta_W \left(1 - \frac{M}{KP_W}\right).$$

Ordinarily, the returns received by farmers after paying wholesalers' commission charges exceed the total of other marketing costs incurred in moving the fruit from the farm to the wholesale market. This means that

$$KP_W > M,\ 0 < \frac{M}{KP_W} < 1, \text{ and } 0 < 1 - \frac{M}{KP_W} < 1.$$

Hence, for the usual case, (1) leads to two conclusions:

(2a) $\eta_F < \eta_W$

(2b) $\eta_F > 1$ provided $\eta_W > KP_W \div (KP_W - M)$.

If, however, farmers receive "red ink" returns, then

$$KP_W < M, \quad \frac{M}{KP_W} > 1, \text{ and } 1 - \frac{M}{KP_W} < 0.$$

In this "unusual" case, η_F and η_W are of opposite sign and which has the greater absolute value depends upon the size of M relative to KP_W.

STATISTICAL APPENDIX

Certain data collected in the course of preparing this report are presented here for the convenience of readers. This compilation is in two parts: (A) "Basic Data" used in making the monthly price analyses, and (B) "Auxiliary Information" gathered for other parts of the report.

Part A includes:

Tables A-1 to A-7: Honolulu wholesale prices, monthly, 1947–62.
Tables A-8 to A-14: Honolulu wholesale supply, monthly, 1947–62.

Part B includes:

Tables B-1 and B-2: Statistical measures for frequency series.
Tables B-3 to B-6 and Figure B-1: Supplemental data on Honolulu deliveries and unloads.
Table B-7 and Figure B-2: Data on economic activity in Hawaii.
Tables B-8 to B-12: Price residuals for regression analysis.

Data for Tables A-1 to A-14 and B-3 to B-6 are compiled from, or based upon, information assembled and published by the Hawaii Crop and Livestock Reporting Service and the Hawaii Federal-State Market News Service. Reports issued by these two governmental agencies may be consulted to obtain (for these and other commodities) additional information, revisions, and current data. All the data used herein come from their annual reports, entitled for 1961, respectively: *Statistics of Hawaiian Agriculture, 1961* and *1961 Honolulu Unloads: Fruits, Vegetables, Meats, Dairy, and Poultry Products.* Somewhat different titles were used in some earlier years. During 1947–51 these data were released annually in a single publication instead of in two reports as is done now.

This evolution in the method of publishing the data and change in titles should not be confusing. Hence, for the sake of simplicity, all references (in this appendix and in the body of the report) to those reports is by means of *Statistics of Hawaiian Agriculture* and *Honolulu Unloads.*

Certain adjustments are included. Derived figures (particularly averages and percentages) are computed from unrounded data and may, of course, vary somewhat from the results indicated by the rounded data shown. When percentage

distributions (of monthly supplies, of deliveries by source, etc.) are determined, their sums may not total 100.0 percent exactly because of rounding. Similarly, 5-year averages of monthly supplies rounded to the nearest 1,000 pounds do not exactly equal the average (rounded) of the five annual totals. In these and other such cases data for the components are modified slightly to give "accurate" totals. (Another researcher might make different "corrections.")

The general practice is followed of using "0" for a quantity to designate either no quantity (zero) or an amount less than 5 in the next significant place. For example, "0" means any quantity less than 5 (including zero) where data are shown to the nearest 10 units, less than 0.5 where data are in units, less than 0.05 where data are given to one decimal place, etc.

There are a few slight discrepancies in data tabulated in different tables. These arise primarily for two reasons. In some cases data were rounded differently. Some reports give revisions in totals without indicating how monthly data (or other components) were changed. In such cases the unrevised data are shown as sums of the components while revised totals are given in other tables. (It did not appear necessary to iron out all of these minor differences for our purposes.)

TABLE A-1

Avocados: Honolulu Wholesale Price for No. 1 Grade (cents per pound),[a/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	15.0	13.1	13.5	12.0	13.8	14.0	14.0	13.3	13.5	13.6	13.6	12.8	13.5
1948	14.5	14.6	14.6	13.7	14.0	13.6	12.9	11.5	13.1	13.2	12.3	12.2	13.4
1949	12.6	13.5	12.1	12.6	13.0	13.1	12.5	12.9	12.4	12.5	12.5	12.0	12.6
1950	12.4	12.4	12.4	12.8	12.8	13.0	12.8	12.8	12.5	12.2	12.5	12.5	12.6
1951	12.5	12.5	12.5	12.6	13.0	13.0	13.0	13.0	12.8	12.7	12.8	12.8	12.8
1952	12.8	12.8	12.4	12.2	12.8	14.5	13.4	11.5	12.1	12.3	12.0	12.5	12.6
1953	12.5	12.5	12.5	12.3	12.2	12.5	12.5	13.0	12.8	13.5	13.4	12.7	12.7
1954	12.9	12.5	12.8	12.6	12.5	12.5	12.5	12.5	12.2	12.5	12.5	12.4	12.5
1955	12.5	12.5	12.0	9.9	11.5	12.5	12.5	11.8	11.7	11.5	11.5	11.5	11.8
1956	11.5	11.5	10.0	10.3	10.6	11.0	12.0	11.3	11.3	12.1	12.1	12.1	11.3
1957	11.5	11.4	9.2	8.5	8.3	9.2	11.5	12.0	11.8	11.5	11.5	11.5	10.7
1958	11.8	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	9.9	9.8	9.4	11.1
1959	9.4	9.4	9.4	9.4	9.4	9.5	9.4	9.4	9.5	9.3	9.3	9.8	9.4
1960	10.6	9.7	9.5	9.4	9.0	9.3	11.0	11.0	11.0	11.0	11.0	11.0	10.3
1961	11.0	10.6	9.3	9.4	10.4	11.0	11.0	11.0	11.0	9.8	9.4	9.3	10.3
1962	9.4	9.1	9.0	9.0	9.0	9.4	9.5	10.6	10.6	10.5	10.6	10.6	9.8
Average													
1947-51	13.4	13.2	13.0	12.7	13.3	13.3	13.0	12.7	12.9	12.8	12.7	12.5	12.98
1952-56	12.4	12.4	11.9	11.5	11.9	12.6	12.6	12.0	12.0	12.4	12.3	12.2	12.19
1957-61	10.9	10.5	9.9	9.6	9.7	10.1	10.9	11.0	11.0	10.3	10.2	10.2	10.34
Percent of season averages													
1947-51	103.3	101.9	100.4	98.2	102.7	102.8	100.5	97.9	99.1	99.0	98.2	96.0	
1952-56	102.1	101.4	98.0	94.0	97.8	103.4	103.2	98.6	98.6	101.6	100.9	100.4	
1957-61	105.0	101.7	94.5	93.2	94.0	97.6	105.2	106.1	105.9	99.6	98.6	98.6	
1947-61	103.5	101.6	97.6	95.1	98.2	101.3	103.0	100.9	101.2	100.1	99.2	98.3	

For footnotes and source see page following Table A-14.

TABLE A-2

Bananas, Apple: Honolulu Wholesale Price of Generally Good Quality (cents per pound),[a/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	7.8	7.8	7.8	8.0	7.9	8.0	7.7	7.5	7.5	6.6	6.1	6.4	7.4
1948	6.4	6.5	6.9	7.0	6.9	6.5	6.4	6.1	6.0	6.1	6.5	6.7	6.5
1949	6.8	7.0	7.5	7.6	7.6	7.9	8.0	8.0	7.8	7.5	7.1	7.0	7.5
1950	7.0	7.5	7.8	7.7	7.7	7.5	7.4	6.8	6.5	6.6	6.5	6.9	7.2
1951	7.7	7.9	8.0	8.0	8.0	8.0	7.8	7.6	7.0	6.2	6.4	6.5	7.4
1952	7.5	7.5	7.7	7.7	7.5	7.5	7.3	6.0	4.6	4.5	5.1	5.5	6.5
1953	5.9	6.5	6.8	6.7	6.4	6.2	5.8	5.5	5.3	4.9	5.5	6.1	6.0
1954	6.5	6.7	7.5	7.5	7.5	7.5	7.5	7.3	6.8	6.5	6.3	6.4	7.0
1955	6.5	6.5	6.5	6.7	6.8	7.0	7.0	7.0	7.0	7.0	6.8	6.7	6.8
1956	7.0	7.1	7.5	7.5	7.7	7.7	7.9	7.2	6.9	6.9	6.9	6.4	7.2
1957	6.1	6.6	6.9	6.9	7.5	7.2	6.0	5.8	5.6	5.5	5.9	5.9	6.3
1958	6.2	6.8	6.9	7.3	7.5	7.5	7.5	7.7	7.5	7.5	7.5	7.5	7.3
1959	7.5	7.6	8.3	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.6	8.6	8.3
1960	8.5	8.5	8.5	8.5	8.5	8.1	7.9	8.0	7.1	7.1	7.1	7.5	7.9
1961	7.9	7.9	8.2	8.3	8.6	9.0	8.8	7.5	6.9	7.0	6.9	6.8	7.8
1962	7.9	7.9	8.8	8.9	9.0	8.9	9.0	8.9	8.9	8.8	8.5	8.5	8.7
Average													
1947-51	7.1	7.3	7.6	7.7	7.6	7.6	7.5	7.2	7.0	6.6	6.5	6.7	7.20
1952-56	6.7	6.9	7.2	7.2	7.2	7.2	7.1	6.6	6.1	6.0	6.1	6.2	6.70
1957-61	7.2	7.5	7.8	7.9	8.1	8.1	7.7	7.5	7.1	7.1	7.2	7.3	7.54
Percent of season averages													
1947-51	99.2	102.0	105.6	106.4	105.8	105.3	103.6	100.0	96.7	91.7	90.6	93.1	
1952-56	99.7	102.3	107.4	107.7	107.1	107.1	105.9	98.5	91.3	88.9	91.3	92.8	
1957-61	96.0	99.2	102.9	104.7	107.7	106.9	102.6	99.4	94.4	94.4	95.5	96.3	
1947-61	98.3	101.2	105.3	106.3	106.9	106.4	104.0	99.3	94.1	91.7	92.4	94.1	

For footnotes and source see page following Table A-14.

TABLE A-3

Bananas, Bluefields: Honolulu Wholesale Price of Generally Good Quality (cents per pound),[a/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	7.8	7.8	7.8	8.0	7.9	8.0	7.7	7.5	7.5	6.6	6.1	6.4	7.4
1948	7.1	7.3	7.7	8.1	8.1	8.3	7.7	7.2	6.2	6.4	7.0	7.3	7.4
1949	7.3	7.8	8.5	9.0	10.0	10.1	10.3	9.8	9.5	8.2	8.0	8.0	8.9
1950	7.8	8.6	9.5	9.5	9.5	9.2	8.8	7.7	7.7	7.8	7.7	8.5	8.5
1951	8.6	8.9	9.1	9.2	9.2	9.3	9.3	9.1	8.1	7.4	7.5	7.6	8.6
1952	8.6	8.8	9.1	9.5	9.1	9.1	9.0	8.2	6.5	5.8	6.3	7.3	8.1
1953	8.0	8.5	8.8	8.7	8.5	8.5	8.2	7.5	7.3	6.7	7.5	8.2	8.0
1954	8.5	8.7	9.5	9.5	9.5	9.5	9.5	9.4	8.9	8.5	8.4	8.5	9.0
1955	8.6	8.8	9.5	9.5	9.5	9.5	9.5	9.5	9.2	9.0	9.0	8.8	9.2
1956	9.0	9.1	9.5	9.5	9.5	9.5	9.5	9.5	9.2	9.0	9.0	9.0	9.3
1957	9.0	9.0	9.0	9.0	9.6	9.5	9.5	9.4	8.6	8.5	8.2	8.5	9.0
1958	9.1	9.5	9.5	9.7	9.9	9.9	10.0	10.3	10.5	10.5	10.5	10.5	10.0
1959	9.9	10.4	11.0	11.0	11.0	11.0	11.0	11.0	11.0	10.2	11.0	11.0	10.8
1960	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	9.3	8.8	8.7	9.0	10.3
1961	10.9	11.0	11.0	11.0	11.0	11.0	11.0	8.8	8.6	8.5	8.6	8.9	10.0
1962	9.0	9.0	10.5	10.5	10.5	10.5	10.5	10.5	9.2	9.5	9.4	9.2	9.9
Average													
1947-51	7.7	8.1	8.5	8.8	8.9	9.0	8.8	8.3	7.8	7.3	7.3	7.6	8.15
1952-56	8.5	8.8	9.3	9.3	9.2	9.2	9.1	8.8	8.2	7.8	8.0	8.4	8.73
1957-61	10.0	10.2	10.3	10.3	10.5	10.5	10.5	10.1	9.6	9.3	9.4	9.6	10.02
Percent of season averages													
1947-51	94.6	99.0	104.4	107.4	109.6	110.0	107.4	101.2	95.6	89.2	89.0	92.6	
1952-56	97.8	100.5	106.3	107.0	105.6	105.6	104.7	101.3	94.1	89.3	92.1	95.7	
1957-61	99.6	101.6	102.8	103.2	104.7	104.6	104.7	100.8	95.8	92.8	93.8	95.6	
1947-61	97.3	100.4	104.5	105.9	106.6	106.7	105.6	101.1	95.2	90.4	91.7	94.6	

For footnotes and source see page following Table A-14.

TABLE A-4

Bananas, Chinese: Honolulu Wholesale Price of Generally Good Quality (cents per pound),[a/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	7.8	7.8	7.8	8.0	7.9	8.0	7.7	7.5	7.5	6.6	6.1	6.4	7.4
1948	5.3	5.6	6.5	6.5	6.5	6.0	5.6	5.4	5.2	5.2	5.5	5.8	5.8
1949	6.5	6.8	7.1	7.1	7.5	7.9	8.0	7.7	7.4	7.0	6.5	6.8	7.2
1950	6.4	--	7.2	7.5	7.5	7.5	7.1	6.3	6.3	6.5	6.1	5.9	6.2
1951	7.0	7.5	7.5	7.5	7.3	7.3	7.3	7.2	6.8	6.0	6.0	6.5	7.0
1952	6.6	6.4	6.5	6.6	6.5	6.5	6.4	5.4	4.8	4.6	5.0	5.6	5.9
1953	5.9	6.4	7.0	7.0	6.7	6.2	5.8	5.6	5.5	5.4	5.4	5.8	6.1
1954	6.6	7.0	7.8	7.8	7.8	7.8	7.8	7.5	6.9	6.8	6.4	6.5	7.2
1955	6.6	6.6	6.7	6.8	6.8	6.8	6.8	7.4	7.4	7.4	7.0	6.7	6.9
1956	7.0	7.5	7.9	7.9	8.0	8.0	8.0	7.3	6.5	6.2	6.0	5.7	7.2
1957	5.6	5.6	5.9	6.2	7.5	7.1	5.9	5.8	5.5	5.0	5.2	5.2	5.9
1958	5.7	6.8	6.9	7.8	7.9	7.9	8.0	8.0	8.0	7.8	7.5	7.5	7.5
1959	7.5	7.7	8.3	8.9	8.5	9.0	8.9	8.2	7.0	7.0	7.0	7.0	7.9
1960	7.6	8.5	8.5	8.4	8.4	8.1	7.9	8.0	7.1	7.1	7.1	7.2	7.8
1961	7.6	7.6	7.9	7.9	8.6	8.9	8.7	7.5	6.9	7.0	6.8	6.8	7.7
1962	7.9	7.8	8.9	8.9	9.0	8.9	9.0	8.9	8.7	8.2	8.1	8.1	8.5
Average													
1947-51	6.6	6.9	7.2	7.3	7.3	7.3	7.1	6.8	6.6	6.3	6.0	6.3	6.83
1952-56	6.5	6.8	7.2	7.2	7.2	7.2	7.0	6.6	6.2	6.1	6.0	6.1	6.66
1957-61	6.8	7.2	7.5	7.8	8.2	8.2	7.9	7.5	6.9	6.8	6.7	6.7	7.36
Percent of season averages													
1947-61	98.3	82.5	107.6	109.0	109.4	109.4	106.4	101.6	98.9	93.3	90.0	93.6	
1952-56	98.3	101.9	107.9	108.5	107.6	106.1	104.6	99.8	93.4	91.3	89.6	91.0	
1957-61	92.4	98.4	101.9	106.6	111.2	111.5	107.1	102.0	93.8	92.2	91.3	91.6	
1947-61	96.3	94.3	105.8	107.9	109.4	109.0	106.1	101.1	95.4	92.3	90.3	92.1	

For footnotes and source see page following Table A-14.

TABLE A-5

Papayas: Honolulu Wholesale Price for No. 1 Grade (cents per pound),[a] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	6.3	6.6	6.8	6.8	6.9	7.0	6.4	7.0	7.0	6.9	6.7	6.9	6.8
1948	6.1	6.4	6.4	3.7	3.6	3.8	2.9	4.9	6.2	5.7	5.7	5.9	5.1
1949	5.8	5.9	6.4	6.9	7.0	7.0	7.0	7.0	7.1	7.8	8.0	8.0	7.0
1950	7.3	7.0	7.0	7.0	7.0	6.1	4.3	3.8	3.5	3.4	2.9	3.0	5.2
1951	2.7	2.5	2.8	6.7	6.4	6.5	6.7	7.8	8.8	9.2	9.4	9.8	6.6
1952	9.8	9.8	9.5	9.0	8.6	6.7	4.6	6.0	6.9	7.8	6.5	6.1	7.6
1953	6.2	6.4	7.5	7.4	4.1	3.2	3.9	5.5	6.4	7.5	7.3	7.6	6.1
1954	7.8	8.8	8.5	8.5	6.6	4.4	4.5	5.9	7.0	7.7	6.0	6.5	6.8
1955	6.9	6.5	7.6	9.0	8.6	8.5	8.2	8.5	8.5	8.5	8.1	7.1	8.0
1956	7.9	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.0	6.8	6.9	8.1
1957	7.1	8.5	9.5	8.6	5.4	4.5	4.7	5.7	6.6	7.5	5.7	6.4	6.7
1958	7.5	7.2	6.5	8.1	7.9	5.8	5.2	6.0	8.4	8.2	7.1	6.9	7.1
1959	6.7	6.5	8.0	9.3	8.8	6.2	6.0	7.0	7.6	7.9	8.1	9.2	7.6
1960	10.3	10.9	11.0	10.9	10.8	8.2	7.9	8.2	8.7	8.7	8.0	7.9	9.3
1961	8.7	9.0	8.9	8.4	6.5	6.3	5.5	6.2	7.6	7.7	7.9	7.8	7.5
1962	7.9	8.4	9.1	9.1	7.8	6.8	7.8	7.9	7.9	7.7	7.1	7.1	7.9
Average													
1947-51	5.6	5.6	5.8	6.2	6.1	6.1	5.4	6.1	6.5	6.6	6.5	6.7	6.14
1952-56	7.7	8.0	8.3	8.4	7.2	6.2	5.9	6.8	7.4	7.9	6.9	6.8	7.34
1957-61	8.0	8.4	8.7	9.0	7.9	6.2	5.8	6.6	7.7	8.0	7.3	7.6	7.64
Percent of season averages													
1947-51	91.9	92.6	95.9	101.4	100.7	99.1	89.0	99.4	106.3	107.6	106.6	109.5	
1952-56	105.2	109.3	113.4	115.6	99.2	85.3	81.0	93.8	101.7	107.7	94.6	93.2	
1957-61	105.5	110.2	115.0	118.6	103.2	81.2	76.7	86.7	101.7	104.8	96.4	100.0	
1947-61	100.9	104.0	108.1	111.9	101.0	88.5	82.3	93.3	103.2	106.7	99.2	100.9	

For footnotes and source see page following Table A-14.

TABLE A-6

Tangerines: Honolulu Wholesale Price for Generally Good Quality (cents per pound),[b/] by months, 1947-62

Year beginning	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Oct.-Mar. average
1947	--	23.7	16.5	11.8	--	--	--	--	12.5
1948	--	--	23.0	16.5	--	--	--	--	17.7
1949	--	--	13.5	8.8	--	--	--	--	10.4
1950	--	20.8	20.2	19.8	--	--	--	--	19.9
1951	--	--	19.8	11.3	--	--	--	--	13.8
1952	--	24.0	22.0	17.0	13.5	14.0	--	--	16.5
1953	--	24.1	24.0	13.8	14.0	16.5	--	--	16.3
1954	--	27.5	17.4	18.0	18.5	19.8	20.0	25.0	18.9
1955	--	--	22.5	11.8	12.0	12.2	--	--	13.3
1956	--	--	29.0	29.0	24.8	21.0	21.0	21.0	25.3
1957	25.0	24.6	21.5	9.6	8.9	11.0	14.0	--	11.7
1958	--	--	22.7	10.7	18.0	24.0	24.0	--	17.0
1959	25.0	22.8	12.2	9.7	10.0	13.3	14.0	--	12.1
1960	--	26.5	20.5	8.4	15.0	21.8	25.0	25.0	16.4
1961	36.5	31.6	16.9	9.5	14.0	15.9	20.9	25.0	14.8
1962	23.4	11.8	11.0						
Average									
1947-51		22.2	18.6	13.6	--	--	--		14.86
1952-56		25.2	23.0	17.9	16.6	16.7	20.5		18.08
1957-61		26.4	18.8	9.6	13.2	17.2	19.6		14.42
Percent of season averages									
1947-51		150.0	125.7	91.9					
1952-56		139.2	127.1	98.9	91.7	92.3	113.3		
1957-61	199.7	183.4	130.6	66.7	91.7	119.4	136.1		
1947-61		157.5	127.8	85.8	91.7	105.8	124.7		

For footnotes and source see page following Table A-14.

TABLE A-7

Watermelons: Honolulu Wholesale Price for Generally Good Quality (cents per pound),[a/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Apr.-Nov. average
1947	20.0	--	30.0	--	22.7	14.1	12.8	15.5	15.2	14.2	16.5	20.0	15.9
1948	20.0	--	--	--	18.3	14.6	10.3	9.8	10.2	16.1	13.1	14.0	13.2
1949	--	--	--	19.6	11.0	8.7	9.9	11.1	14.0	13.0	8.2	--	11.9
1950	20.0	18.5	18.0	13.0	13.5	8.5	7.2	6.7	7.6	7.7	8.2	10.9	9.0
1951	--	--	--	--	15.0	13.7	10.0	6.4	6.8	6.0	7.5	7.5	9.3
1952	--	--	--	21.0	14.7	8.2	6.2	8.4	6.9	7.0	7.0	--	9.9
1953	--	--	--	16.2	11.9	8.2	7.2	7.8	7.5	7.4	9.8	--	9.5
1954	--	--	18.0	17.5	14.1	8.7	8.4	8.9	8.2	8.9	8.5	15.0	10.4
1955	--	--	19.6	16.9	13.0	10.7	6.6	5.7	5.4	6.2	7.5	8.5	9.0
1956	--	--	--	--	14.0	10.3	8.9	9.5	9.5	9.5	--	--	10.3
1957	--	--	--	23.5	14.6	9.0	9.0	9.8	9.1	8.5	--	--	11.9
1958	--	--	24.0	18.4	10.2	9.3	8.2	8.1	9.5	11.0	--	--	10.9
1959	--	--	--	16.3	14.5	9.6	9.5	9.9	10.0	--	13.0	13.0	11.8
1960	25.0	21.5	21.3	18.9	15.2	15.0	8.2	9.4	9.5	10.3	11.0	--	12.2
1961	--	19.0	19.0	18.4	15.9	11.1	11.7	11.6	9.8	10.2	10.5	--	12.4
1962				23.0	18.7	11.8	9.8	8.5	8.9	9.0	9.0	--	14.1
Average													
1947-51	20.00	18.50	24.00	16.30	16.10	11.92	10.04	9.90	10.76	11.40	10.70	13.10	11.80
1952-56	--	--	18.80	17.90	13.54	9.22	7.46	8.06	7.50	7.80	8.20	11.75	9.80
1957-61	25.00	20.25	21.43	19.10	14.08	10.80	9.32	9.76	9.58	10.00	11.50	13.00	11.83
Percent of Apr.-Nov. averages													
1947-51			203.4	137.3	136.4	101.0	85.1	83.9	91.2	96.6	90.7	111.0	
1952-56			191.8	182.7	138.2	94.1	76.1	82.2	76.5	79.6	83.7	119.9	
1957-61			181.1	161.5	119.0	91.3	78.8	82.5	81.0	84.5	97.2	109.9	
1947-61			192.4	163.1	130.9	95.7	80.3	82.8	83.4	87.2	90.4	114.1	

For footnotes and source see page following Table A-14.

TABLE A-8

Avocados: Honolulu Wholesale Supply (1,000 pounds),[b/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	81	53	89	56	22	28	42	35	44	77	49	65	641
1948	71	66	79	64	60	22	41	37	80	94	94	57	765
1949	55	81	83	51	30	17	36	63	57	59	77	45	654
1950	52	73	61	61	64	51	44	54	59	60	72	56	707
1951	69	59	97	79	46	38	28	61	54	77	70	70	748
1952	63	78	66	78	46	32	52	49	44	63	61	55	687
1953	67	74	86	91	67	47	33	40	30	37	64	45	681
1954	57	65	66	80	49	30	36	39	66	53	53	47	641
1955	60	85	125	100	80	39	26	48	52	68	74	25	782
1956	48	89	83	81	78	62	49	52	47	55	39	47	730
1957	61	63	71	89	91	38	40	27	40	52	52	48	672
1958	54	47	64	71	49	29	35	18	48	44	70	57	586
1959	36	55	90	53	35	31	34	41	57	69	58	52	611
1960	55	82	74	76	56	34	18	15	22	43	62	46	583
1961	47	71	61	55	57	45	34	46	47	71	67	43	644
1962	66	65	68	59	61	36	38	37	44	72	43	37	626
Average													
1947-51	65.6	66.4	81.8	62.2	44.4	31.2	38.2	50.0	58.8	73.4	72.4	58.6	703.0
1952-56	59.0	78.2	85.2	86.0	64.0	42.0	39.2	45.6	47.8	55.2	58.2	43.8	704.2
1957-61	50.6	63.6	72.0	68.8	57.6	35.4	32.2	29.4	42.8	55.8	61.8	49.2	619.2
Percent of season totals													
1947-51	9.3	9.5	11.6	8.9	6.3	4.5	5.4	7.1	8.4	10.4	10.3	8.3	
1952-56	8.4	11.1	12.1	12.2	9.1	5.9	5.6	6.5	6.8	7.8	8.3	6.2	
1957-61	8.2	10.3	11.6	11.1	9.3	5.7	5.2	4.8	6.9	9.0	10.0	7.9	
1947-61	8.6	10.3	11.8	10.7	8.2	5.4	5.4	6.1	7.4	9.1	9.5	7.5	

For footnotes and source see page following Table A-14.

TABLE A-9

Bananas: Honolulu Wholesale Supply (1,000 pounds),[b/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	732	693	703	699	707	700	734	743	776	778	755	754	8,774
1948	659	669	724	708	718	742	736	731	752	738	731	685	8,593
1949	510	390	345	324	352	403	403	486	474	576	517	485	5,265
1950	511	367	429	374	420	389	485	487	409	482	358	330	5,041
1951	415	487	448	450	423	426	419	488	506	515	482	430	5,489
1952	484	484	475	467	467	491	530	578	620	638	601	544	6,379
1953	550	554	562	547	564	582	592	614	605	588	543	510	6,811
1954	485	465	467	452	423	445	459	517	516	541	543	529	5,842
1955	556	515	532	497	505	460	504	544	554	587	578	545	6,377
1956	533	502	465	435	442	467	515	562	566	634	613	592	6,326
1957	579	555	523	503	501	508	535	563	584	568	550	518	6,487
1958	527	478	496	460	458	479	501	527	562	572	550	533	6,143
1959	561	497	499	483	504	497	538	623	602	612	606	604	6,626
1960	356	364	375	346	420	418	478	638	670	758	697	651	6,171
1961	569	530	583	468	526	595	689	732	806	870	734	668	7,770
1962	749	451	460	443	489	449	559	591	608	708	612	616	6,735
Average													
1947-51	565.4	521.2	529.8	511.0	524.0	532.0	555.4	587.0	583.4	617.8	568.6	536.8	6,632.4
1952-56	521.6	504.0	500.2	479.6	480.2	489.0	520.0	563.0	572.2	597.6	575.6	544.0	6,347.0
1957-61	518.4	484.8	495.2	452.0	481.8	499.4	548.2	616.6	644.8	676.0	627.4	594.8	6,639.4
Percent of season totals													
1947-51	8.5	7.9	8.0	7.7	7.9	8.0	8.4	8.8	8.8	9.3	8.6	8.1	
1952-56	8.2	7.9	7.9	7.5	7.6	7.7	8.2	8.9	9.0	9.4	9.1	8.6	
1957-61	7.8	7.3	7.4	6.8	7.3	7.5	8.3	9.3	9.7	10.2	9.4	9.0	
1947-61	8.2	7.7	7.8	7.3	7.6	7.7	8.3	9.0	9.2	9.6	9.0	8.6	

For footnotes and source see page following Table A-14.

TABLE A-10

Papayas: Honolulu Wholesale Supply (1,000 pounds),[b] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	325	375	306	267	380	501	685	410	450	505	445	390	5,039
1948	440	410	682	624	530	643	528	425	470	570	575	504	6,401
1949	476	428	452	425	475	501	453	400	375	370	375	380	5,110
1950	500	450	452	400	600	625	650	700	650	800	775	600	7,202
1951	750	675	650	500	403	406	418	326	265	340	316	302	5,351
1952	290	290	326	354	449	560	568	599	591	598	653	563	5,841
1953	602	566	589	639	905	850	809	603	601	745	742	642	8,293
1954	629	581	646	650	717	704	765	432	570	529	677	589	7,489
1955	722	686	564	581	723	698	705	507	503	488	821	786	7,784
1956	573	553	604	638	669	636	588	698	664	903	826	750	8,102
1957	776	658	757	996	1,028	1,053	1,056	938	820	981	1,032	770	10,865
1958	862	906	938	747	936	1,271	1,136	887	914	1,100	1,009	1,036	11,742
1959	937	823	700	718	1,028	1,226	1,144	1,026	914	1,016	944	694	11,170
1960	494	688	608	635	921	996	751	731	794	1,057	900	820	9,395
1961	726	676	848	982	1,158	978	1,034	818	949	955	1,045	995	11,164
1962	947	582	476	681	1,119	892	850	734	640	967	781	589	9,258
Average													
1947-51	498.2	467.6	508.4	443.2	477.6	535.2	546.8	452.2	442.0	517.0	497.2	435.2	5,820.6
1952-56	563.2	535.2	545.8	572.4	692.6	689.6	687.0	567.8	585.8	652.6	743.8	666.0	7,501.8
1957-61	759.0	750.2	770.2	815.6	1,014.2	1,104.8	1,024.2	880.0	878.2	1,021.8	986.0	863.0	10,867.2
Percent of season totals													
1947-51	8.6	8.0	8.7	7.6	8.2	9.2	9.4	7.8	7.6	8.9	8.5	7.5	
1952-56	7.5	7.1	7.3	7.6	9.2	9.2	9.2	7.6	7.8	8.7	9.9	8.9	
1957-61	7.0	6.9	7.1	7.5	9.3	10.2	9.4	8.1	8.1	9.4	9.1	7.9	
1947-61	7.7	7.3	7.7	7.6	8.9	9.5	9.3	7.9	7.8	9.0	9.2	8.1	

For footnotes and source see page following Table A-14.

TABLE A-11

Tangerines: Honolulu Wholesale Supply (1,000 pounds),[b/] by months, 1947-62

Season beginning	Earlier	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Later	Total
1947	0	8	4	154	92	70	14	5	1	348
1948	0	0	53	243	40	1	7	0	0	344
1949	0	6	72	143	50	20	13	0	6	310
1950	0	6	46	132	84	62	27	7	0	364
1951	0	3	69	161	56	26	16	2	1	334
1952	0	4	59	168	75	78	15	2	0	401
1953	0	4	67	145	88	50	39	10	12	415
1954	2	27	72	167	85	65	12	1	3	434
1955	0	1	57	182	134	65	25	8	7	479
1956	0	6	18	144	126	90	34	16	4	438
1957	11	9	81	259	115	51	6	4	1	537
1958	0	6	99	205	84	64	30	10	2	500
1959	3	75	168	264	133	37	25	3	1	709
1960	0	10	205	204	79	56	58	5	0	617
1961	15	49	243	220	150	38	24	5	1	745
1962	7	118	166	217						
Average										
1947-51	0	4.6	48.8	166.6	64.4	35.8	15.4	2.8	1.6	340.0
1952-56	0.4	8.4	54.6	161.2	101.6	69.6	25.0	7.4	5.2	433.4
1957-61	5.8	29.8	159.2	230.4	112.2	49.2	28.6	5.4	1.0	621.6
Percent of season totals										
1947-51	0	1.4	14.4	49.0	18.9	10.5	4.5	0.8	0.5	100.0
1952-56	0.1	1.9	12.6	37.2	23.4	16.1	5.8	1.7	1.2	100.0
1957-61	0.9	4.8	25.6	37.1	18.0	7.9	4.6	0.9	0.2	100.0
1947-61	0.3	2.7	17.5	41.1	20.1	11.5	5.1	1.1	0.6	100.0

For footnotes and source see page following Table A-14.

TABLE A-12

Oranges: Honolulu Wholesale Supply (1,000 pounds),[b/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	264	833	1,431	1,323	2,498	236	779	1,147	988	921	1,273	1,402	13,095
1948	1,132	1,301	2,022	1,224	1,178	1,148	666	1,265	46	149	134	1,809	12,074
1949	858	680	806	1,018	286	554	534	320	762	1,004	688	787	8,297
1950	718	876	898	895	851	939	660	737	746	657	330	1,143	9,450
1951	800	1,077	928	1,000	1,492	811	1,044	613	816	620	749	1,246	11,196
1952	793	982	940	1,069	630	454	637	701	530	644	211	1,248	8,839
1953	674	1,045	915	1,027	946	869	357	709	787	870	555	990	9,744
1954	973	886	887	1,163	842	571	609	539	725	488	743	1,096	9,522
1955	569	1,214	986	823	1,391	565	630	386	406	904	467	1,005	9,346
1956	632	940	1,223	1,100	893	758	596	591	403	505	634	1,277	9,552
1957	624	635	1,236	927	1,290	723	590	669	455	645	682	1,059	9,535
1958	708	959	877	1,241	1,042	439	294	516	663	692	232	833	8,496
1959	921	585	640	1,720	464	536	927	314	535	910	494	789	8,835
1960	822	748	897	1,123	775	287	335	286	501	558	267	876	7,475
1961	685	983	966	809	487	300	814	450	477	477	318	768	7,534
1962	820	402	866	369	809	575	12	198	530	363	364	970	6,278
Average													
1947-51	754.4	953.4	1,217.0	1,092.0	1,261.0	737.6	736.6	816.4	671.6	670.2	634.8	1,277.4	10,822.4
1952-56	728.2	1,013.4	990.2	1,036.4	940.4	643.4	565.8	585.2	570.2	682.2	522.0	1,123.2	9,400.6
1957-61	752.0	782.0	923.2	1,164.0	811.6	457.0	592.0	447.0	526.2	656.4	398.6	865.0	8,375.0
Percent of season totals													
1947-51	7.0	8.8	11.2	10.1	11.7	6.8	6.8	7.5	6.2	6.2	5.9	11.8	
1952-56	7.8	10.8	10.5	11.0	10.0	6.8	6.0	6.2	6.1	7.3	5.6	11.9	
1957-61	9.0	9.3	11.0	13.9	9.7	5.5	7.1	5.3	6.3	7.8	4.8	10.3	
1947-61	7.9	9.6	10.9	11.7	10.5	6.4	6.6	6.3	6.2	7.1	5.5	11.3	

For footnotes and source see page following Table A-14.

TABLE A-13

Watermelons: Honolulu Wholesale Supply (1,000 pounds),[b] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947	1	0	14	10	510	1,289	934	356	373	384	91	7	3,969
1948	6	0	0	39	516	1,636	1,277	1,470	704	216	315	25	6,204
1949	0	1	1	105	1,006	1,540	524	190	200	223	80	25	3,895
1950	1	23	28	358	556	1,362	1,001	831	430	265	50	11	4,916
1951	1	0	0	0	178	642	1,674	837	546	230	40	11	4,159
1952	1	0	10	40	886	1,430	790	531	474	198	30	5	4,395
1953	0	0	10	247	694	840	653	582	379	202	50	10	3,667
1954	0	5	48	78	505	835	537	588	398	160	25	6	3,185
1955	5	0	28	107	222	599	978	846	421	205	110	11	3,532
1956	1	1	5	22	310	640	544	499	334	219	20	0	2,595
1957	1	3	11	89	419	885	790	504	299	179	30	5	3,215
1958	0	2	21	191	717	926	976	405	299	28	10	0	3,575
1959	0	2	4	185	357	1,056	905	502	294	64	9	7	3,385
1960	1	127	295	403	801	534	183	355	318	98	3	0	3,118
1961	7	14	35	147	382	748	610	725	466	27	12	0	3,173
1962	0	0	1	11	483	859	1,071	856	433	115	20	5	3,854
Average													
1947-51	1.8	4.8	8.6	102.4	553.2	1,293.8	1,082.0	736.8	450.6	263.6	115.2	15.8	4,628.6
1952-56	1.4	1.2	20.2	98.8	523.4	868.8	698.4	609.2	401.2	196.8	49.0	6.4	3,474.8
1957-61	1.8	29.6	73.2	203.0	535.2	829.8	692.8	498.2	335.2	79.2	12.8	2.4	3,293.2
Percent of season totals													
1947-51	0	0.1	0.2	2.2	12.0	28.0	23.4	15.9	9.7	5.7	2.5	0.3	
1952-56	0	0	0.6	2.8	15.1	25.0	20.2	17.5	11.5	5.7	1.4	0.2	
1957-61	0.1	0.9	2.2	6.2	16.2	25.2	21.0	15.1	10.2	2.4	0.4	0.1	
1947-61	0	0.3	0.9	3.6	14.1	26.3	21.7	16.2	10.4	4.7	1.6	0.2	

For footnotes and source see page following Table A-14.

TABLE A-14

Other Melons: Honolulu Wholesale Supply (1,000 pounds),[b/] by months, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947					47	401	360	491	249	207	31		1,786
1948				3	24	236	330	437	85	0	0		1,115
1949					0	0	19	41	45	21	12		138
1950					128	306	226	261	192	213	0		1,326
1951					81	132	358	213	271	171	62		1,288
1952					8	100	0	270	355	121	49		903
1953					22	181	229	231	285	114	58		1,120
1954			3	10	66	167	347	335	300	162	30		1,420
1955	9	1	0	2	3	111	246	248	166	172	76	2	1,036
1956			4	26	54	227	301	439	320	277	8		1,656
1957		15	2	5	24	166	228	278	245	134	15	4	1,116
1958				12	36	137	276	332	361	87	21	12	1,274
1959				7	55	131	412	353	199	66	25	6	1,254
1960				11	31	165	266	309	270	96	2		1,150
1961		9	4	1	55	126	314	299	265	18	5		1,096
1962			--	5	67	147	355	281	200	106	7		1,168
Average													
1947-51				0.6	56.0	215.0	258.6	288.6	168.4	122.4	21.0		1,130.6
1952-56	1.8	0.2	1.4	7.6	30.6	157.2	224.6	304.6	285.2	169.2	44.2	0.4	1,227.0
1957-61		5.2	1.2	7.2	40.2	145.0	299.2	314.2	268.0	80.2	13.6	4.4	1,178.4
Percent of season totals													
1947-51	0	0	0	0.1	4.9	19.0	22.9	25.5	14.9	10.8	1.9	0	
1952-56	0.2	0	0.1	0.6	2.5	12.8	18.3	24.8	23.3	13.8	3.6	0	
1957-61	0	0.4	0.1	0.6	3.4	12.3	25.4	26.7	22.7	6.8	1.2	0.4	
1947-61	0.1	0.2	0.1	0.4	3.6	14.6	22.1	25.7	20.4	10.5	2.2	0.1	

For footnotes and source see following page.

FOOTNOTES AND SOURCES FOR TABLES A-1 TO A-14

[a] Prices are for Hawaii-produced fruit of the designated grade. A blank indicates no price reported for that particular month. Banana prices for 1947 are monthly averages for all varieties. Season and 5-year averages are simple averages computed from the monthly prices, except for tangerines for which monthly prices (for October–March) are weighted by monthly supply and for watermelons for which a simple average for April–November is shown. Each "percent of season average" is computed from the unrounded monthly averages for the period indicated. (Note: The Market News Service reports price quotations for each Tuesday and Thursday "for stock of generally good quality in trucklot or part trucklot quantities sold to retailers and restaurants by wholesalers or producers." A simple average of the midpoints of these ranges for the Tuesdays and Thursdays of a calendar month is reported as the price for that month.)

[b] Supplies include Oahu marketings and unloads from all other sources. In the case of avocados, however, only unloads are included—Oahu production is small. Banana supplies include cooking bananas. Supplies for "other melons" include all melons other than watermelons—i.e., cantaloupes, honeydews, casabas, Cranshaws, and Persians. A blank indicates no supply reported for that particular month.

Each "percent of season total" is computed from the unrounded monthly averages for the period indicated. Values of less than 0.05 are shown as "0." (Note: Season totals were revised slightly in a few years. The unrevised totals are shown here, however, unless monthly data were also revised. Usually such revisions were negligible. Several larger changes were made in 1,000 pounds: for watermelons, 1953—3,667 to 3,540; for papayas, 1951—5,351 to 5,101; 1952—5,841 to 5,941; 1953—8,293 to 7,768; 1954—7,489 to 8,489; 1957—10,865 to 11,005.)

Source: Prices for tables A-1 to A-7 are from *Hawaiian Agriculture,* annual reports for 1947–62—table 15 in the 1962 report and comparable tables for other years. Supplies for tables A-8 to A-14 are from *Honolulu Unloads,* annual reports for 1947–62—primarily tables 2, 3, and 5 in the 1962 report and comparable tables for other years.

TABLE B-1

Fruits: Statistical Measures for Frequency Series,[a] 1947-61

Item and measure[b]		Monthly data				Annual data
		1947-51	1952-56	1957-61	1947-61	1947-61
Price--cents per pound						
Avocados	M	12.98	12.19	10.34	11.84	11.77
	SD	0.69	0.87	1.01	1.39	1.27
	V	5.35	7.14	9.76	11.73	10.80
Bananas, Chinese	M	6.83	6.66	7.34	6.94	6.91
	SD	0.80	0.72	1.14	1.42	0.72
	V	11.70	10.75	15.49	20.46	10.40
Papayas	M	6.14	7.34	7.64	7.04	7.05
	SD	1.72	1.48	1.51	1.70	1.06
	V	28.12	20.14	19.75	24.20	14.98
Tangerines	M	17.14	19.50	17.14	18.03	16.12
	SD	4.66	5.20	6.32	5.75	3.65
	V	27.18	26.65	36.87	31.87	22.64
Watermelons	M	11.81	9.98	11.83	11.13	12.07
	SD	3.97	3.35	3.61	3.85	2.30
	V	33.63	33.62	30.50	34.62	19.06
Supply--1,000 pounds						
Avocados	M	58.58	58.68	51.60	56.29	675.47
	SD	5.87	6.21	5.52	5.97	59.61
	V	10.02	10.59	10.70	10.60	8.82
Bananas	M	552.70	528.92	553.33	544.97	6,539.33
	SD	148.54	54.30	103.02	109.40	1,053.40
	V	26.88	10.27	18.62	20.07	16.10
Papayas	M	485.05	625.15	905.60	671.97	8,062.67
	SD	129.96	130.75	159.87	224.43	2,259.27
	V	26.79	20.91	17.65	33.40	28.07
Tangerines	M	98.27	80.64	103.79	93.95	465.00
	SD	70.87	51.68	81.83	70.56	130.55
	V	72.11	64.09	78.84	75.11	28.08
Watermelons	M	620.51	452.26	416.53	499.76	3,801.33
	SD	484.58	313.74	320.40	386.06	850.76
	V	78.09	69.37	76.92	77.25	22.38

a/ For price and supply data as described in Tables A-1 to A-14, except that computations for monthly data covers periods of Oct.-Mar. for tangerines and Apr.-Nov. for watermelons.

b/ Symbols used are: M--mean; SD--standard deviation; V--coefficient of variation, computed as 100 SD ÷ M, using unrounded data.

Source: Computed from data in Tables A-1 to A-14.

TABLE B-2

Five Fruits: Estimated Price and Supply and Statistical Measures for 1947-61, with comparisons

Item	Estimated values[a] for					Statistical measures[b]					Bend point[c]	
	1948	1951	1957	1960	1963	M	SD	A	B	C	Value	Date
Price--cents per pound												
Avocados	13.28	12.67	11.03	9.99	8.82	11.773	1.272	11.920	- 0.274	- 0.008		
Bananas, Apple	7.17	6.79	7.10	7.80	8.85	7.140	0.612	6.769	0.052	0.020	6.74	Mar. 1953
Bananas, Bluefield	7.82	8.34	9.54	10.22	10.96	8.967	0.980	8.909	0.200	0.003		
Bananas, Chinese	6.83	6.55	6.94	7.60	8.57	6.913	0.719	6.588	0.064	0.017	6.53	May 1952
Papayas	6.14	6.57	7.50	8.00	8.52	7.047	1.056	7.023	0.155	0.001		
Tangerines	14.27	16.22	16.55	14.93	12.12	15.747	3,649	16.981	0.055	- 0.066	*16.98	Nov. 1954
Watermelons	14.41	11.04	10.78	13.89	19.15	12.067	2.300	9.830	- 0.044	0.120	9.83	Sept.1954
Supply--1,000 pounds												
Avocados	692	708	669	614	535	675.5	59.61	700.0	- 6.47	- 1.312	*708	Jan. 1952
Bananas	7,374	6,251	6,084	7,039	8,688	6,539.3	1,053.40	5,820.8	- 27.86	38.491	5,816	Nov. 1954
Papayas	5,418	6,594	9,377	10,984	12,734	8,062.7	2,259.27	7,913.8	463.82	7.976		
Tangerines	339	361	526	669	854	465.0	130.55	422.7	27.51	2.264	339	June 1948
Watermelons	4,799	4,119	3,293	3,147	3,180	3,801.3	850.76	3,616.4	-137.68	9.909	3,135	June 1961
Citrus fruits	13,817	13,129	11,982	11,523	11,139	12,598	1,545.9	12,517.7	-191.21	4.231		
Tropical fruits	13,588	13,718	16,290	18,731	21,943	15,418	2,466.0	14,618.7	428.61	42.803	13,546	June 1949
Melons	6,006	5,277	4,461	4,374	4,500	4,984	272.4	4,762.2	-136.00	11.883	4,373	Mar. 1960
Other fruits	9,373	9,591	10,480	11,151	11,973	10,116	1,267.2	9,960.3	148.22	8.376	9,305	Aug. 1945
Total fruits	42,793	41,718	43,211	45,779	49,562	43,116	3,554.4	41,857.3	248.93	67,464	41,628	Aug. 1952
Vine vegetables	9,545	9,912	10,717	11,156	11,619	10,328	864.9	10,302.4	134.29	1.335		
Root vegetables	13,965	13,911	14,222	14,587	15,092	14,141	698.4	13,996.4	51.86	7.763	13,910	Feb. 1951
Leafy vegetables	12,671	12,885	15,129	17,159	19,794	14,332	1,886.0	13,704.5	374.00	33.617	12,664	Dec. 1948
Other vegetables	4,644	4,777	5,463	6,015	6,706	5,194	693.0	5,050.0	114.25	7.748	4,629	Feb. 1947
Total vegetables	40,824	41,482	45,528	48,916	53,214	43,995	1,174.6	43,050.4	674.29	50.551	40,802	Nov. 1947
Fruits and vegetables	83,617	83,200	88,739	94,695	102,776	87,111	d/	84,907.7	923.22	118.015	83,103	Aug. 1950
Potatoes	13,830	17,131	22,296	24,160	25,545	19,457	4,093.6	19,952.6	860.8	- 26.604		

a/ Estimated by the parabolic trend $Y = A + BT + CT^2$ where T is time measured in years from 1954 and coefficients have the values shown to the right. The estimate for 1954 is the value of A.

b/ The 15 annual prices (or quantities) were used to determine, by the method of least squares, the "best" parabolic trend for 1947-61. Symbols used are: M--mean; SD--standard deviation; A, B, and C--coefficients in the regression equation.

c/ Value at and date for maximum or minimum on trend. Maximum is denoted by *. Other values are for minimum points. The bend point is shown only if it occurs within the period 1943-65.

d/ Not computed.

Source: The annual data used for computing the statistical measures are given in Appendix Tables A-1 to A-14 and B-4.

TABLE B-3

Fruits: Deliveries to Honolulu (1,000 pounds), by months and origin,[a] 1957-61 average

Origin	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Avocados													
Hawaii	43	55	61	57	45	27	23	21	36	47	48	36	499
Kauai	2	1	0	0	0	0	5	6	5	5	5	3	32
Maui	5	8	11	12	13	8	4	2	2	4	9	10	88
Total[a]	50	64	72	69	58	35	32	29	43	56	62	49	619
Bananas													
Oahu	460	434	439	399	419	423	451.	482	506	524	499	483	5,519
Hawaii	38	37	35	33	34	37	36	49	59	66	62	62	548
Kauai	14	9	14	15	21	28	45	66	58	64	51	39	424
Maui	5	3	6	4	7	7	11	15	16	17	12	9	112
Molokai	1	2	1	1	1	3	5	5	6	5	3	2	35
Imports	0	0	0	0	0	1	0	0	0	0	0	0	1
Total	518	485	495	452	482	499	548	617	645	676	627	595	6,639
Papayas													
Oahu	371	360	422	477	585	560	513	428	393	471	432	380	5,392
Hawaii	372	375	324	305	385	513	491	437	472	534	542	475	5,225
Kauai	3	2	2	5	5	3	1	1	1	1	2	2	28
Maui	2	3	11	13	18	14	9	7	8	10	6	4	105
Molokai	11	10	11	16	21	15	10	7	4	6	4	2	117
Total	759	750	770	816	1,014	1,105	1,024	880	878	1,022	986	863	10,867
Tangerines													
Hawaii	66	26	11	4	1		1	1	3	30	151	177	471
Maui	1	0	0	0	0						1	1	3
Imports	40	34	20	4	1						7	52	158
Total[a]	107	60	31	8	2	0	1	1	3	30	159	230	632
Watermelons													
Oahu	0	23	58	149	423	696	526	222	78	31	9	1	2,216
Hawaii	1	1	0	0	1	1	0	0	0	0			4
Kauai	0	0	1	24	33	24	28	9	14	1			134
Maui	1	6	14	30	53	33	4	9	5	7	4	1	167
Molokai					5	6	10	6	4	3			34
Imports					20	70	125	252	234	37			738
Total	2	30	73	203	535	830	693	498	335	79	13	2	3,293

[a] Avocado total is for unloads only since Oahu production (which is small) is not reported. All imports are from the U.S. Mainland except for 3,000 pounds of watermelons in March 1961.

Source: "Honolulu Unloads," annual reports, 1957 to 1961.

TABLE B-4

Fresh Fruits and Vegetables: Annual Deliveries to Honolulu,[a/] 1947-61

Year	Fruits					Vegetables					Fruits & Vegs.	Potatoes
	Citrus	Tropical	Melons	Other	Total	Leafy	Root	Vine	Other	Total		
					1,000 pounds							
1947	16,192	14,660	5,756	11,978	48,586	14,520	15,219	10,221	5,470	45,430	94,016	15,180
1948	14,564	15,862	7,364	7,458	45,248	15,263	13,267	10,061	4,872	43,463	88,711	13,558
1949	10,545	11,185	4,258	8,217	34,205	12,992	13,586	9,357	3,844	39,779	73,984	14,171
1950	11,764	12,960	6,197	9,438	40,359	13,536	13,861	8,884	4,431	40,712	81,071	14,446
1951	14,523	11,595	5,448	9,900	41,466	13,852	13,547	8,877	4,330	40,606	82,072	17,374
1952	11,394	13,098	5,298	8,567	38,357	13,287	12,781	9,912	4,233	40,213	78,570	14,431
1953	12,634	15,342	4,660	9,614	42,250	14,761	14,066	9,839	4,868	43,534	85,784	18,931
1954	12,900	15,016	4,605	10,787	43,308	16,160	14,835	9,831	5,429	46,255	89,563	21,201
1955	12,623	15,099	4,568	9,516	41,806	17,616	13,565	11,412	5,416	48,009	89,815	21,123
1956	13,241	15,197	4,251	11,636	44,325	18,743	15,176	11,548	5,876	51,343	95,668	22,215
1957	13,227	18,372	4,331	10,767	46,697	18,747	14,645	11,017	6,094	50,503	97,200	23,829
1958	11,867	18,588	4,849	11,248	46,552	19,487	14,591	11,372	5,756	51,206	97,758	25,925
1959	12,135	18,429	4,639	10,981	46,184	19,380	14,375	11,242	5,459	50,456	96,640	23,432
1960	10,632	16,244	4,263	11,161	42,300	19,732	13,882	10,512	5,926	50,052	92,352	22,505
1961	10,732	19,616	4,269	10,480	45,097	20,247	14,713	10,830	5,908	51,698	96,795	23,505
Average												
1947-51	13,518	13,252	5,805	9,398	41,973	14,033	13,896	9,480	4,589	41,998	83,971	14,946
1952-56	12,558	14,751	4,676	10,024	42,009	16,114	14,085	10,508	5,164	45,871	87,880	19,580
1957-61	11,719	18,250	4,470	10,927	45,366	19,518	14,441	10,995	5,829	50,783	96,149	23,839
1947-61	12,598	15,418	4,984	10,116	43,116	16,555	14,141	10,328	5,194	46,218	89,334	19,455
1957-61 average					Origin--percent of total							
Oahu	0	59.8	51.4	0	29.0	34.5	21.2	36.7	37.8	31.6	30.4	0
Hawaii	6.0	34.4	0.1	0.1	15.3	8.4	4.5	16.9	15.6	10.0	12.5	0
Other islands[b/]	0	5.8	8.2	0.3	3.2	37.0	10.5	28.6	8.9	24.4	14.4	0.4
Imports[c/]	94.0	0	40.3	99.6	52.5	20.1	63.8	17.8	37.7	34.0	42.7	99.6

a/ The major items omitted by the source data are deliveries of pineapples and Oahu marketings of avocados and mangos. This exclusion understates the importance of Oahu as a source of tropical fruits (and of all fruits).

b/ Maui is a more important source of Honolulu supplies for most of these products than Kauai and Molokai combined.

c/ Includes unloads from sources other than the islands. They come predominately from the U. S. Mainland.

Source: "Honolulu Unloads," annual reports.

TABLE B-5

Fresh Fruits, Vegetables, and Potatoes: Honolulu Unloads from Foreign Countries, 1947-61[a/]

Commodity	1948	1949	1952	1954	1957	1958	1959	1960	1961	Average 1947-56	Average 1957-61
					1,000 pounds						
Apples	1,391	542	36	170	120	947	952	996	1,212	236.2	845.4
Pears	59	161			45	81			43	22.0	33.8
Plums					1	55	16	23	27	0	24.4
Other fruits[b/]		69				3		1	46	6.9	10.0
Fruits	1,450	772	36	170	166	1,086	968	1,020	1,328	265.1	913.6
Onions, dry	716	46	712			220	903		419	147.4	308.4
Cabbage, head		30	84						0	11.4	0
Carrots	446	205	122	4					60	77.7	12.0
Cauliflower	5	11	12						0	2.8	0
Celery	225	183	94						24	50.2	4.8
Garlic	28	33	54						20	13.4	4.0
Ginger root		1	10			10			0	5.9	2.0
Lettuce		0	14						24	1.4	4.8
Tomatoes	24	42	12						18	7.8	3.6
Other vegetables[c/]	44	7	1						4	5.7	0.8
Vegetables	1,488	558	1,115	4	0	230	903	0	569	323.7	340.4
Potatoes	2,362	451	1,306	195						431.4	0
Total	5,300	1,781	2,457	369	166	1,316	1,871	1,020	1,897	1,020.2	1,254.0

a/ Foreign unloads were zero in 1947, 1955, and 1956. In the other unlisted years they were (in 1,000 pounds):
1950--apples, 176; garlic, 8; unspecified vegetables, 2; total, 186.
1951--apples, 7; garlic, 2; ginger root, 47; unspecified vegetables, 3; total, 59.
1953--apples, 40; garlic, 9; ginger root, 1; total, 50.

b/ These quantities consisted entirely of peaches in 1949 and of cherries in 1958 and 1960. The 1961 figure includes grapefruit, 11; oranges, 32; watermelon, 3.

c/ The quantities (in 1,000 pounds) were:
1948--pumpkin, 4; turnips, 7; squash, 25; unspecified, 8.
1949--peppers, 1; turnips, 1; squash, 1; unspecified, 4.
1952--dasheen, 1.
1961--burdock, 4.

Source: "Honolulu Unloads," annual reports.

TABLE B-6

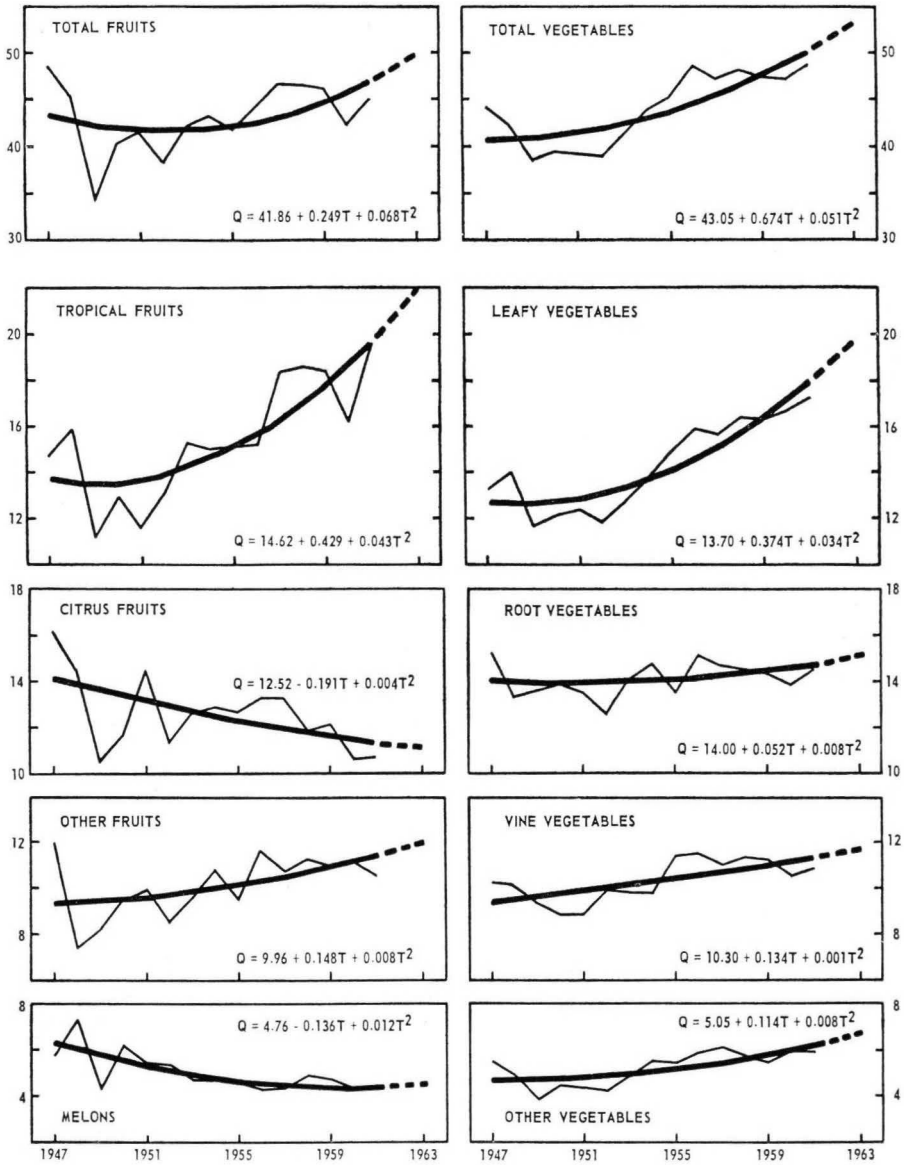
Frozen Fruits, Vegetables, and Juices: Honolulu Unloads from the U. S. Mainland, 1947-61[a/]

Commodity	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	Averages 1948-51	Averages 1952-56	Averages 1957-61
			Frozen fruits and vegetables--1,000 pounds										
Berries	309	396	304	315	346	302	264	282	263	308	326.3	334.0	283.8
Other fruits	95	86	89	110	102	99	81	117	124	134	59.3	96.4	111.0
Fruits	404	482	393	425	448	401	345	399	387	442	385.6	430.4	394.8
Beans, lima	115	107	118	132	131	128	139	131	115	102	75.8	120.6	123.0
Beans, snap	125	152	163	206	226	267	255	268	269	237	74.5	174.4	259.2
Broccoli	82	106	116	123	155	190	179	194	172	169	53.7	116.4	180.8
Corn	89	98	105	123	186	191	195	235	244	295	89.5	120.2	232.0
Peas	228	237	336	355	401	460	443	458	450	460	183.5	311.4	454.2
Peas/carrots	44	60	55	76	107	126	140	146	158	154	24.8	68.4	144.8
Potatoes	25	44	41	57	80	89	87	114	161	207	11.5	49.4	131.6
Spinach	74	78	88	104	137	127	103	141	135	138	47.8	96.2	128.8
Succotash	12	13	20	20	31	27	20	17	12	12	10.7	19.2	17.6
Mixed vegetables	80	105	134	158	185	197	195	225	215	185	52.5	132.4	203.4
Other vegetables	102	138	157	158	165	176	134	151	109	124	97.5	144.0	138.8
Vegetables	976	1,138	1,333	1,512	1,804	1,978	1,890	2,080	2,040	2,083	721.8	1,352.6	2,014.2
Unspecified	60	30	8	13	3	8	6	7	10	0	39.3	22.8	6.2
			Frozen juices--1,000 gallons										
Orange	49.2	42.2	51.2	47.0	59.3	64.2	39.1	48.3	53.1	64.8		49.76	53.90
Lemonade	2.0	10.2	9.8	8.4	8.0	10.3	8.7	10.4	6.3	9.5		7.68	9.03
Other citrus	4.3	7.8	6.2	5.7	11.5	8.6	5.0	6.6	6.0	5.7		7.11	6.39
Grape	3.0	5.5	5.2	4.9	8.0	7.8	5.4	7.5	9.1	9.5		5.33	7.87
Unspecified	1.0	1.1	.1	.3	.3	.5	.4	.4	.3	.3		.56	.37
Juices	59.5	66.8	72.5	66.3	87.1	91.4	58.6	73.2	74.8	89.8		70.44	77.56

a/ Unloads of frozen fruits and frozen vegetables (exclusive of unspecified items) were (in 1,000 pounds), respectively: 868 and 1,197 in 1947 (the first year reported); 260 and 605 in 1948; 353 and 734 in 1949; 447 and 730 in 1950; 482 and 818 in 1951. Unloads of frozen juices totalled 45,788 gallons in 1951, the first year for which they were reported.

Source: "Honolulu Unloads," annual reports.

FIGURE B-1. Fresh fruits and vegetables: Annual deliveries to Honolulu wholesale market, 1947–61—million pounds.



NOTE: In the trend equations, T is time measured in years from 1954.

Based on Tables B-2 and B-4.

TABLE B-7

Economic Activity in Hawaii: Consumer Prices, Personal Income, and Population, 1940-62

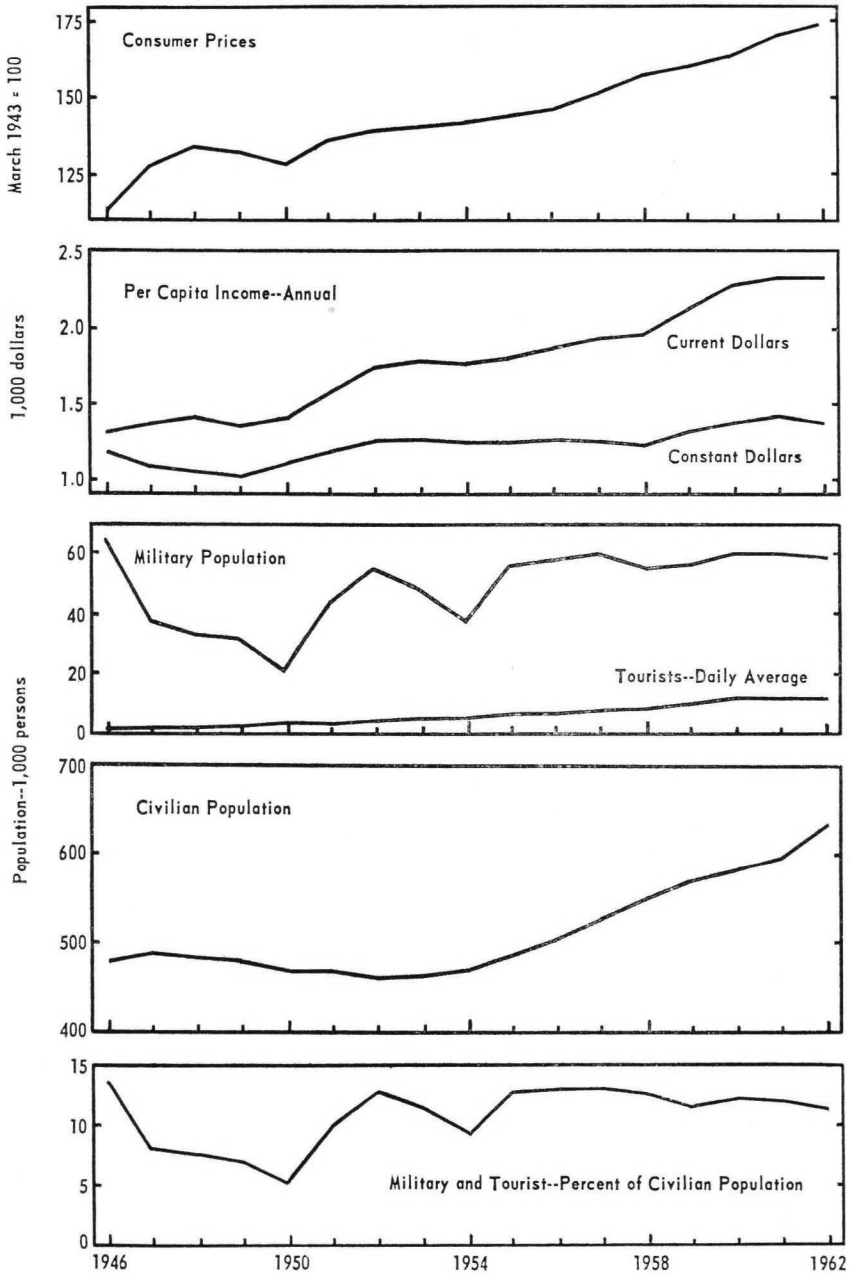
Year	Consumer Prices[a] (1943 = 100)	Personal Income (dollars per capita)		Population, as of July 1 (1,000 persons)			Tourists			Military and Tourists (per 1,000 civilian residents)		
		Current	Real	Total	Military	Civilian	Total per year	Average per day	Average stay (days)	Military	Tourists	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
Annual												
1940	77.9	577	741	428	30	398	25,400			75.1		
1945	104.3	1,328	1,273	815	355	460				771.7		
1946	111.3	1,312	1,179	545	65	480	15,000	980	23.7	135.4	2.0	137.4
1947	127.5	1,384	1,085	526	38	488	25,000	1,620	23.7	77.9	3.3	81.2
1948	134.1	1,411	1,052	517	33	484	36,400	2,370	23.7	68.2	4.9	73.1
1949	132.2	1,354	1,024	511	31	480	34,400	2,240	23.7	64.6	4.7	69.3
1950	127.7	1,403	1,099	491	21	470	46,600	3,030	23.7	44.7	6.4	51.1
1951	135.7	1,589	1,171	513	44	469	51,600	3,350	23.7	93.8	7.1	100.9
1952	139.2	1,745	1,254	515	55	460	60,500	3,800	22.9	119.6	8.3	127.9
1953	140.4	1,782	1,269	511	48	463	80,300	4,750	21.6	103.7	10.3	114.0
1954	141.8	1,768	1,247	507	38	469	91,300	5,370	21.4	81.0	11.4	92.4
1955	143.8	1,789	1,244	541	56	485	109,800	6,040	20.1	115.5	12.5	128.0
1956	145.8	1,862	1,277	561	58	503	133,800	6,950	18.9	115.3	13.8	129.1
1957	151.0	1,916	1,269	585	60	525	168,800	8,200	17.7	114.3	15.6	129.9
1958	157.4	1,946	1,236	605	55	550	171,600	8,400	17.9	110.0	15.3	125.3
1959	160.5	2,118	1,320	620	56	564	243,200	10,390	15.6	99.3	18.4	117.7
1960	164.2	2,274[b]	1,385	642	60	582	296,500	11,800	14.5	103.1	20.3	123.4
1961	169.7[b]	2,407[b]	1,418	657	60	597	319,400	11,960	13.7	100.5	20.0	120.5
1962[c]	173.8	2,409	1,386	691	59	632	362,100	11,900	12.0	93.4	18.8	112.2
Average												
1947-51	131.4	1,428	1,086	511.6	33.4	478.2	38,800	2,522	23.7	69.8	5.3	75.1
1952-56	142.2	1,789	1,258	527.0	51.0	476.0	95,140	5,382	21.0	107.0	11.3	118.3
1957-61	160.6	2,132	1,326	621.8	58.2	563.6	239,900	10,150	15.9	105.4	17.9	123.4

a/ Index for all items, combined, for Honolulu, March 1943 = 100.
b/ Revisions to source data from government reports.
c/ Preliminary--generally based on government reports.

Sources: Columns 2, 3, and 5-9 are from Hawaii State Department of Planning and Research, "Historical Statistics of Hawaii, 1778-1962," September 1962 (41 pp., proc.), pages 7, 15, and 22.
Other data are derived as follows:

Col. 4 = Col. 3 ÷ Col. 2
Col. 10 = 365 x Col. 9 ÷ Col. 8
Col. 11 = 1,000 x Col. 6 ÷ Col. 7
Col. 12 = 1,000 x Col. 9 ÷ Col. 7
Col. 13 = Col. 11 + Col. 12

FIGURE B-2. Consumer prices, income, and population, Hawaii, 1946–62.



Based on Table B-7.

TABLE B-8

Avocados: Price residuals (cents per pound) for monthly analysis, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	2.30	-0.40	0.78	-0.50	0.20	0.62	0.90	0	0.25	0.98	0.50	0.02	0.47
1948	1.15	1.05	1.72	0.80	1.20	0.02	-0.38	-0.80	0.55	0.78	-0.10	-0.80	0.43
1949	-0.75	0.50	-0.70	-0.50	-0.40	-0.60	-0.70	0.15	-0.55	-0.42	-0.10	-1.15	-0.44
1950	-0.95	-0.70	-0.68	-0.05	0.20	0.22	-0.35	-0.05	-0.35	-0.68	-0.15	-0.40	-0.33
1951	-0.30	-0.65	0.08	0.20	0.15	0.08	-0.38	0.45	0	0.28	0.30	0.25	0.04
1952	0	0.20	-0.22	0	0.15	1.62	0.95	-1.10	-0.70	-0.18	-0.45	-0.15	0.01
1953	0	0	0.38	0.45	0.20	0.18	-0.35	0.40	-0.15	0.68	1.20	0.15	0.26
1954	0.45	0.10	0.62	0.85	0.40	0.02	0.15	0.15	0.32	0.28	0.35	0.08	0.31
1955	0.40	0.70	0.82	-1.25	0.25	0.58	0.20	-0.05	-0.15	-0.12	0.05	-1.00	0.04
1956	-0.40	0.15	-1.22	-0.70	-0.25	-0.08	0.55	-0.10	-0.30	0.68	0.35	0.50	-0.07
1957	0.40	0.25	-0.78	-1.85	-1.80	-1.92	-0.50	-0.45	-0.40	-0.48	-0.45	-0.50	-0.71
1958	1.05	0.50	1.02	1.35	1.15	0.78	0.85	0.35	0.95	-0.72	-0.30	-0.95	0.50
1959	-1.45	-1.15	-0.32	-0.75	-0.95	-0.88	-0.95	-0.85	-0.55	-0.52	-0.70	-0.35	-0.78
1960	0.25	-0.25	-0.38	-0.25	-0.80	-0.88	0.35	0.15	0.25	0.78	1.15	0.85	0.10
1961	0.35	0.35	-0.92	-0.70	-0.50	0.92	0.65	0.85	0.75	0.02	-0.45	-1.00	0.03
1962	-0.18	-0.55	-0.35	-0.35	-0.17	-0.48	-0.32	0.72	0.85	1.52	0.65	0.32	0.14
Average a/													
1947-51	0.29	-0.04	0.24	-0.01	0.27	0.07	-0.18	-0.05	-0.02	0.19	0.09	-0.42	0.036
1952-56	0.09	0.23	0.08	-0.13	0.15	0.46	0.30	-0.14	-0.20	0.27	0.30	-0.08	0.111
1957-61	0.12	-0.06	-0.28	-0.44	-0.58	-0.40	0.08	0.01	0.20	-0.18	-0.15	-0.39	-0.172
1947-61	0.17	0.04	0.01	-0.19	-0.05	0.04	0.07	-0.06	-0.01	0.09	0.08	-0.30	-0.009

a/ The mean and standard deviation for the monthly residuals (1947-61) are -0.00861 and 0.68953. The correlation coefficient is R = 0.8678.

Source: Derived from the regressions presented in the text applied to data in Tables A-1 and A-8.

TABLE B-9

Bananas, Chinese: Price residuals (cents per pound) for monthly analysis, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	1.18	0.80	0.68	0.75	0.58	0.62	0.50	0.48	0.82	0.12	-0.30	0.08	0.53
1948	-1.02	-0.60	0.12	-0.10	-0.15	-0.55	-0.95	-1.05	-0.92	-0.82	-0.38	-0.20	-0.55
1949	-0.15	-0.70	-0.88	-1.12	-0.65	0.05	0.18	0.50	0.30	0.65	0.02	0.22	-0.13
1950	0.08	--	0.08	-0.10	0.05	-0.12	0.05	-0.60	-0.85	-0.05	-1.02	-1.25	-0.34
1951	0.28	1.00	0.62	0.52	0.02	0.05	0.05	0.48	0.38	-0.15	-0.22	-0.15	0.24
1952	0.32	-0.02	-0.15	-0.25	-0.45	-0.32	-0.20	-0.78	-0.98	-0.88	-0.50	-0.10	-0.36
1953	-0.08	0.28	0.78	0.52	0.22	-0.18	-0.50	-0.52	-0.38	-0.38	-0.45	-0.15	-0.07
1954	0.18	0.30	0.92	0.78	0.42	0.52	0.65	0.82	0.42	0.65	0.45	0.55	0.56
1955	0.40	0	0	-0.18	-0.25	-0.50	-0.22	0.72	0.92	1.30	1.02	0.65	0.32
1956	0.48	0.65	0.85	0.38	0.38	0.52	0.90	0.48	-0.10	-0.35	0.02	-0.28	0.33
1957	0.92	-1.20	-1.25	-1.22	-0.02	-0.40	-1.40	-1.22	-1.22	-1.58	-1.35	-1.40	-0.94
1958	-1.35	-0.70	-0.68	-0.10	-0.12	0	0.22	0.42	0.88	0.95	0.65	0.70	0.07
1959	0.30	0	0.42	0.85	0.42	0.82	1.00	0.90	-0.12	0.02	0.20	0.28	0.42
1960	-1.08	-0.30	0.18	-0.80	-0.50	-0.80	-0.68	0.45	-0.05	0.52	0.42	0.40	-0.19
1961	-0.22	-0.62	-0.22	-0.98	-0.08	0.58	0.90	0	-0.05	0.55	-0.10	-0.28	-0.04
1962	0.55	-1.28	-0.30	-0.22	-0.25	-0.62	0.25	0.32	0.40	0.60	0.20	0.28	-0.01
Average a/													
1947-51	0.07	0.12	0.12	-0.01	-0.03	0.01	-0.03	-0.04	-0.05	-0.05	-0.38	-0.26	-0.046
1952-56	0.26	0.24	0.48	0.25	0.06	0.01	0.13	0.14	-0.02	0.07	0.11	0.13	0.155
1957-61	-0.29	-0.56	-0.31	-0.45	-0.06	0.04	0.01	0.11	-0.11	0.09	-0.04	-0.06	-0.136
1947-61	0.02	-0.08	0.10	-0.07	-0.01	0.02	0.03	0.07	-0.06	0.04	-0.10	-0.06	-0.009

a/ The mean and standard deviation for the monthly residuals (1947-61) are -0.00883 and 0.63031. The correlation coefficient is R = 0.8961.

Source: Derived from the regressions presented in the text applied to data in Tables A-4 and A-9.

TABLE B-10

Papayas: Price residuals (cents per pound) for monthly analysis, 1947-62

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1947	-0.60	0.10	-0.95	-1.60	-0.38	1.35	2.80	1.30	1.00	0.50	0.05	0.35	0.33
1948	0.35	0.25	2.15	-1.35	-2.25	-0.58	-1.95	-0.60	0.40	-0.10	0.25	0.40	-0.25
1949	0.25	-0.15	0.05	0	0.50	1.28	1.35	1.10	0.30	0.08	0.60	1.15	0.54
1950	1.68	0.82	0.32	-0.48	1.32	1.15	0.10	0.35	-1.12	-0.98	-1.35	-2.08	-0.02
1951	-1.25	-2.15	-2.55	-0.25	-1.45	-0.80	0	0.50	0.20	0.42	0.72	1.60	-0.42
1952	1.20	1.10	0.65	0.15	0.62	0.25	-1.30	0.65	0.75	0.85	0.30	-0.22	0.42
1953	-0.10	-0.30	0.50	0.52	-0.70	-1.50	-0.60	-0.40	-0.18	1.20	1.25	1.35	0.08
1954	1.03	1.55	1.40	1.00	-0.30	-2.08	-0.50	-2.18	-0.58	-1.10	-1.25	-0.88	-0.32
1955	0.25	-0.52	-0.95	0.30	1.05	1.25	1.55	0.45	-0.30	-1.30	1.35	0.70	0.32
1956	-0.65	-0.20	-0.35	-0.35	-0.10	0.10	0.20	1.40	0.40	0.92	-0.55	-0.45	0.03
1957	-0.38	-0.05	1.30	1.90	-1.08	-1.32	-0.58	-0.10	-0.80	0.40	-0.75	-1.40	-0.24
1958	0.15	0.10	-0.85	-1.00	0.20	0.82	-0.10	-0.78	1.15	1.35	-0.05	0.55	0.13
1959	-0.50	-1.70	-1.65	-0.48	1.35	0.50	0.32	0.82	-0.10	0.05	0.08	-0.20	-0.12
1960	-0.80	1.35	0.30	0.10	2.28	0.70	-0.92	-0.50	-0.22	0.80	-0.70	-0.80	0.13
1961	-0.60	-0.80	-0.05	0.15	-0.58	-1.45	-1.38	-1.92	-0.30	-1.05	0.10	0.25	-0.64
1962	0.60	-1.68	-2.65	-1.15	0.75	-1.30	-0.08	-0.62	-2.10	-0.62	-2.38	-3.32	-1.21
Average a/													
1947-51	0.09	-0.23	-0.20	-0.74	-0.45	0.48	0.46	0.53	0.16	-0.02	0.05	0.28	0.035
1952-56	0.35	0.33	0.25	0.32	0.11	-0.40	-0.13	-0.02	0.02	0.11	0.22	0.10	0.106
1957-61	-0.43	-0.22	-0.19	0.13	0.43	-0.15	-0.53	-0.50	-0.05	0.31	-0.26	-0.32	-0.148
1947-61	0	-0.04	-0.04	-0.09	0.03	-0.02	-0.07	0.01	0.04	0.14	0	0.02	-0.002

a/ The mean and standard deviation for the monthly residuals (1947-61) are -0.00222 and 0.98384. The correlation coefficient is R = 0.8163.

Source: Derived from the regressions presented in the text applied to data in Tables A-5 and A-10.

TABLE B-11

Tangerines: Price residuals (cents per pound) for monthly analysis, 1947-62

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Average
1947	-0.2	- 0.3	1.1				0.20
1948		- 0.1	7.3				3.60
1949		- 5.4	-5.0				-5.20
1950	-5.1	- 2.0	7.1				0
1951		0.5	-0.7				-0.10
1952	-2.5	- 1.0	5.0	-1.8	-0.7		-0.20
1953	-1.2	3.2	0.3	0.4	0.6		0.66
1954	0.5	- 2.1	5.3	2.6	5.2	0.1	1.93
1955		1.0	-1.0	-2.4	-3.3		-1.42
1956	2.9	12.9	-9.0	5.6	5.9	0.7	3.17
1957	-1.8	2.0	-2.7	-5.4	-4.7	-6.8	-3.23
1958		0.6	-2.5	4.2	6.6	2.9	2.36
1959	-0.8	- 6.4	-2.5	-3.1	-3.7	-5.8	-3.72
1960	-0.1	0.8	-4.2	0	6.6	6.4	1.58
1961	5.6	- 1.5	-3.3	1.4	-2.9	1.3	0.10
1962	-2.0	- 7.5	-0.8				
Average a/							
1947-51	-2.65	- 1.46	1.96				-0.233
1952-56	-0.08	2.80	0.12	0.88	1.54	0.40	1.046
1957-61	0.72	- 0.90	-3.04	-0.58	0.38	-0.40	-0.683
1947-61	-0.27	0.15	-0.32	0.15	0.96	-0.17	0.069

a/ The mean and standard deviation for the monthly residuals (1947-61) are 0.06866 and 4.04822. The correlation coefficient is R = 0.7059.

Source: Derived from the regressions presented in the text applied to data in Tables A-6 and A-11.

TABLE B-12

Watermelons: Price residuals (cents per pound) for monthly analysis, 1947-62

Year	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Average
1947		2.1	-0.9	-3.0	-1.1	-0.1	-0.1	0.9	-0.31
1948		0.8	3.3	-0.4	1.0	-0.2	3.6	2.0	1.44
1949	-0.2	-1.3	-0.2	-1.4	-1.0	3.2	3.3	-2.1	0.04
1950	-3.8	0.1	0.4	-1.5	-0.4	-0.4	-0.7	-1.3	-0.95
1951		-0.1	3.4	4.5	-0.1	-0.4	-1.8	-1.5	0.57
1952	2.6	3.8	0.9	-1.5	0.3	-0.1	-1.0	-1.9	0.39
1953	-0.6	0.1	-0.9	-1.3	0	-0.2	-0.8	1.0	-0.34
1954	-0.6	1.0	-0.7	-0.9	1.3	0.4	0.4	-0.5	0.05
1955	-1.2	-1.8	-0.1	-0.5	-1.0	-1.5	-0.8	-0.7	-0.95
1956		-0.6	-0.3	-0.8	1.0	1.1	0.9		0.22
1957	4.6	0.3	-0.8	0.4	1.0	0.1	-0.4		0.74
1958	0	-2.7	-0.6	-0.9	-1.5	0.2	0.7		-0.69
1959	-2.4	-0.6	0.1	0.8	0.6	0.4		2.8	0.24
1960	1.4	2.2	2.4	-3.9	-1.1	-0.1	-0.1	0.3	0.14
1961	-1.2	0	-0.6	0.8	2.6	0.6	-1.2	-0.6	0.05
1962	2.1	3.4	0.4	0.8	-0.2	-1.2	-2.7	-3.1	-0.06
Average a/									
1947-51	-2.00	0.32	1.20	-0.36	-0.32	0.42	0.86	-0.40	0.124
1952-56	0.05	0.50	-0.22	-1.00	0.32	-0.06	-0.26	-0.42	-0.145
1957-61	0.48	-0.16	0.10	-0.56	0.32	0.24	-0.25	0.83	0.097
1947-61	-0.13	0.22	0.36	-0.64	-0.10	0.20	0.14	-0.13	0.024

a/ The mean and standard deviation for the monthly residuals (1947-61) are 0.02411 and 1.56669. The correlation coefficient is R = 0.9466.

Source: Derived from the regressions presented in the text applied to data in Tables A-7 and A-13.

UNIVERSITY OF HAWAII
COLLEGE OF TROPICAL AGRICULTURE
HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII

THOMAS H. HAMILTON
President of the University

DALE N. GOODELL
Acting Dean of the College and
Acting Director of the Experiment Station

GEORGE STANFORD
Acting Associate Director of the Experiment Station